American Meteorological Journal.

A Monthly Review of Meteorology

—AND—

Allied Branches of Study.

Vol. II. JUNE, 1885. No. 2.

Entered at Detroit Post Office as Second-Class Matter.

W. H. BURR PUBLISHING CO.,

DETROIT, - - MICH.

Agent for German and Austrian States:

F. A. BROCKHAUS, - Leipsic, Berlin and Vienna.

Single Copies, 25 Cents. - - Per Annum, $2.00.

In European Countries, $2.25.

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THE AMERICAN

Meteorological Journal.

VOL. II. DETROIT, JUNE, 1885. NO. 2.

CURRENT NOTES.

WEATHER PREDICTIONS.—Owing to some misunderstanding, it was stated in the last number of this JOURNAL that Mr. Sherman and Mr. Clayton were working on the same basis in making the weather predictions. The two methods differ essentially, and it is hoped that a comparison of results for a few months will determine which method is the more reliable. ED.

June Predictions.—If we suppose the United States divided into three equal parts by lines running north and south, it is probable that in the central part the mean temperature and pressure for June will be below the normal and precipitation above; while in the eastern part the pressure and temperature will probably be above the normal. Going more into detail, it is probable that between the 1st and 10th of June the period of high pressure which prevailed over the eastern part during the middle and latter part of May will be replaced by lower pressure and cooler cloudy weather, followed in turn by a period of higher pressure and warmer weather between the 15th and 25th. The remaining parts of the month will probably be nearer normal.

H. HELM CLAYTON.

Mr. Sherman's Review and Forecast.—My forecast of May weather for eastern Michigan, made April 25, was: "Between May 3d and 10th a period of comparatively low barometer, with skies much

clouded, and considerable rain; and opening between the 10th and 18th, a period of cold rains with much north wind, and low temperature when the skies are clear, continuing until near the end of the month."

The first part of this forecast was exactly verified, the rainy period continuing until the 10th and 11th. On the 12th and 13th a warm period opened, coming with a chinook current from the Pacific Ocean through British America, and passing entirely north of Montana territory. I first noticed this current at Qu'Appelle, in the north-west territory, on the morning of May 11. The warm period continued until the evening of the 18th, when the cold wave reached central Michigan. This lasted two or three days, and was overwhelmed on the 21st and 22d by the chinook, which sent the temperature up to 78 at 6 o'clock on the morning of the 20th, at Fort Garry, Manitoba.

My prediction for the last half of May has not been fulfilled. It was stated that the cold area prevailing during the latter part of April in Montana, Wyoming and Colorado, would probably reach eastern Michigan from the 10th to the 18th. It did reach the Mississippi valley early in May, with heavy frosts and considerable snow, but before it could get to Michigan the chinook, which had been forcing its way through the north-west territory, swept down through Manitoba and Minnesota, and overwhelmed it with warmth. The lack of signal stations in the north-west territory and British Columbia, renders it impossible to note the advance of areas of heat or cold north of western Dakota, Montana, Idaho and Washington territory, and it is evident that spring and summer predictions cannot be accurate without them.

The advance of the chinook which has brought warm weather to the Mississippi valley and the country eastward, from the 11th of May up to this date (May 25), is strictly in accordance with the theory set forth in my article on "A Theory of the Chinook," published in the May number of the JOURNAL. This great belt of warm and moist air passed north of Idaho and Montana, leaving a vast cold area from those territories southward to Arizona, as shown on the daily maps of the Signal Service, and after bringing summer heat to Manitoba, came down upon the lake regions as hot north-west winds.

The absence of reports from the north-west territory, toward which we must, just now, look for the advance of weather areas, renders it quite impossible to make predictions that could be

regarded with confidence, for the month of June. Comparatively low temperature now prevails in Washington Territory, Oregon, Idaho, Montana, Colorado, Wyoming and Utah, and the advance of this area eastward, bringing chilly weather the 10th and 20th of June, and perhaps later, might reasonably be anticipated were it not for the unknown element prevailing, in the vast northwest territory, the power of which has been seen since the 12th day of May. While an average of pleasant weather in June the present year seems probable, I think it also likely that the present chinook from the north-west territory will have spent its force by June 1st or soon after, and that the month may bring severe, unpleasant and chilly weather. With reports from signal stations throughout the northwest territory and up the Pacific coast to Alaska, I believe that very accurate summer and autumn predictions might be made a month in advance. LOREN A. SHERMAN.

DESTRUCTIVE FLOODS occurred in the St. Lawrence during the latter part of April.

THE THUNDER-STORM POSTALS for the study of the storms of the present year have been issued by the Signal Office.

SMOKE TO PREVENT FROSTS.—This method of preventing frosts by heavy fumes of smoke is well known in the Old World and was imported from there to this country. It seems to have also been indigenous in America, and has been employed in New Mexico from time immemorial.

PROFESSOR T. C. MENDENHALL has resigned his professorship in the University at Columbus, and is now connected with the U. S. Signal service. This is a notable addition to the able scientific corps of the Service, and the appointment illustrates again the enlightened policy of the Chief Signal Officer.

MR. A. J. PHINEY, OF MUNCIE, IND., sends us a brief account of a hailstorm which occurred there on April 17. All day preceding the storm the temperature was below 50° and air misty with an appearance of rain, though little fell. Light shower about 5:30 P. M., followed by a thickening of the clouds in every direction with heavy thunder in the S. W. About 6:30 rain began to fall,

and, in a few minutes after, hail; wind N. E. light. Hailstones averaged about as large as hickory-nuts with opaque nucleus surrounded by transparent ice enclosed in opaque covering. After the storm the ground appeared white. The storm was accompanied by heavy thunder; two houses in the city were struck, and considerable damage was done at Indianapolis and east of Muncie. The storm came from some point between north and southwest. One or two persons reported a peculiar greenish color in the clouds. After the storm the clouds were moving rapidly from N. E., and the air seemed warmer than it had during the day. A similar storm occurred in Jefferson county. This storm was peculiar in that it occurred on the north side of a cyclone, with a cool air all day, and scarcely any contrasts of temperature; as Mr. Phiney points out. A glance at the weather map, however, shows that while it was comparatively cool there, the temperature was higher in that section of country than on either side of it, and there was probably a rapid vertical decrease of temperature. The cyclone with which it was connected expired over that very section of country the next morning, and Muncie was probably near the center when the hail-storm occurred.

PROTECTION AGAINST LIGHTNING.

In his *Experimental Researches*, paragraphs 1173 *et seq.*, Faraday describes the miniature house he had built to test the question of protection from electrical discharges. It was a hollow cube some twelve feet high, wound around completely on the outside with wire. "I went into the cube," he says, "and lived in it, but though I used lighted candles, electrometers, and all other tests of electrical states, I could not find the least influence upon them, or indication of anything particular, given by them, though all the time the outside of the cube was powerfully charged and large sparks and brushes were starting off, from every point of its outer surface." Faraday's experiment is further exemplified in all modern forms of electrometers. It is necessary, of course, to shield the essential parts of the instrument from external electrical influences, and to do this the enclosing walls are generally tin-foiled, making practically an outer metallic covering. From mathematical considerations, it follows that the potential within a hollow conducting globe is constant.. Electrical action external to

this globe can have no effect on bodies within it, because their potentials being the same there is no difference of potential, and, consequently, no work can be done. From these considerations it is evident that a metallic covering would afford to objects within certain protection against lightning. Maxwell, who did for electricity mathematically what Faraday did for it experimentally, in 1876, suggested to the British Association the plan based on the experiment of Faraday's quoted above,—of protecting a building from the effects of lightning by surrounding it with a sort of cage of rods or stout wire. The suggestion has not yet been applied practically to any extent, but nevertheless it remains the only suggestion of any value made in connection with the question of protection against lightning during the past fifty years. The effective lightning protector of the future will certainly be one based on Maxwell's suggestion. The lightning-rod as it now exists is not, as is too frequently supposed, a modification of Faraday's external metallic shield. The theory of the lightning-rod's action is altogether different from that of a metallic covering. The lightning-rod's efficiency depends on the properties of points in dealing with electricity. If an electrified body is brought near a conductor, it induces on that conductor an opposite electrification and is more or less attracted to it. If we fix a point to the conductor it will, under certain conditions, give off the induced electricity to the air, which, if it come in contact with the inducing body will neutralize a like amount of the opposite electricity. A thunder-cloud being an electrified body induces on the earth a charge of opposite nature and the lightning-rod affords means for a partial neutralization. As Prof. Tait puts it, "a lightning-rod serves, rather to prevent the occurrence than to ward off the effect of the lightning flash." Experience shows very plainly that lightning-rods are useless against ball discharges of lightning or, in fact, any intense disruptive discharge. The theory of the rod's action requires that this should be so. Ordinarily as the thunder-cloud approaches, a convective discharge or glow occurs at the point of the lightning conductor (always provided that this is in good conducting connection with the ground) an evidence of the escape of electricity of an opposite kind, and a consequent neutralizing of that of the cloud. This silent discharge of course tends to prevent the disruptive discharge in which the danger lies. Under certain conditions lightning-rods may be forced to carry a disruptive discharge, a use for which clearly they are not primarily designed, and in

which failure to retain and lead off the current imperils bodies in the vicinity of the rod.

Prof. Le Conte has pointed out (*Nature*, Feb. 24, 1881) that the path of the discharge, whether disruptive or convective, depends upon five variable conditions:—

"1. *Distance* of the thunder-cloud from the point of the conductor.

2. Variable dielectric properties of the intervening air.

3. Size of the cloud.

4. The variable tension of its electrical charge especially under the neutralizing action of the pointed rod.

5. The *velocity* with which the thunder-cloud approaches the point of the conductor, this last consideration being very important and at the same time difficult to formulate."

The rod may be inadequate to overcome the result of a sudden variation in one or more of these conditions, in which case a disruptive discharge of a violence correspondingly to the degree of the variation must ensue. The question then is, whether the lightning conductor affords a more attractive path to this electricity of high tension than other objects in the immediate neighborhood. If the rod does, it is eminently a protector; if it does not, it is a source of danger.

The space protected by a lightning conductor, is not, as is often laid down in treatises on the matter, a circular space whose radius is twice the height of the rod. Such a rule has never been verified experimentally, nor is there any good theoretical reason why it should be so.

As to the actual construction of lightning-rods in this country, a brief inspection of all the patents issued in the United States during the past six years on lightning-rods may be both profitable and interesting. The number of patents awarded is surprisingly small.

	Rods.	Conductors.	Couplings.
In 1878 patents were awarded for	1	1	1
" 1879 " " " "	3	1	3
" 1880 " " " "	1	0	2
" 1881 " " " "	2	0	0
" 1882 " " " "	0	0	5
" 1883 " " " "	4	5	2
" 1884 " " " "	0	1	0
In all	11	8	13

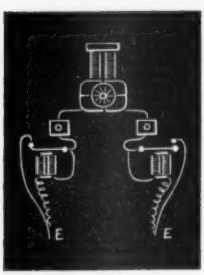
In addition to these there were patented: One machine for making lightning conductors at the place of erection, the inventor of

which is a Down-Easter; four devices for protecting oil tanks, all of which are common connections of the metal of the tank to the ground; one lightning-rod ornament, one lightning rod stand, and one tripod stand. The distinction between the rod and the conductor is that the rod is that part of the conductor which is pointed. Among these patents there is no one device especially ingenious or noteworthy. Good couplings are important, for a poor connection between sections of the conductor may easily render the whole worse than useless. The construction of a good coupling, however, is not difficult. Any good metallic binding that will hold fast and is not exposed to rust is sufficient. Several of the couplings patented seem well adapted for their purpose. Among these are couplings consisting of metallic boxes, hollowed out and secured to the sections of the rod by compression or screws. All forms of screw couplings are good, as is also the form consisting of a thimble in one section and a spring catch in the other, provided these connections are all non-corrosive.

Among the lightning conductors may be noticed an independent, isolated, self-supporting lightning conductor, somewhat as figured in the diagram. Another form of conductor consists of a straight hollow zinc core, covered with sheet copper, and a series of twisted encircling tubes of zinc covered with sheet copper. It is to be noticed here that in the construction of lightning rods no advantage can be taken of the fact that electricity resides on the surface. A hollow metallic tube is of little value as a lightning conductor. With one exception, the only other conductor worth noticing is a cable composed of twisted copper wires. This is an unobjectionable form of conductor, if the diameter of the cable be a trifle greater than $\frac{1}{4}$ inch. A good form of conductor and rod is exemplified in one of the later patents consisting of a flexible conductor, presumably a cable similar to the one previously described, lettered G in the accompanying diagram—in combination with the tube B applied to its upper end, the tip D applied at the upper end of the tube, and the rod A sup-

porting such a tip. One patentee calls his invention by the proper name of the lightning-rod, viz: that of a lightning diffuser or neutralizer. It consists of an electrical conductor placed in a vertical position, and provided with one or more points at its upper and lower ends. These conductors are attached to different parts of the building and have no metallic connection with each other or with the ground. This is in no sense a lightning-rod, and the writer knows not what its special mission may be. In another patent the gutters of the roof are connected with a ground terminal, consisting of a slitted tube, by an open trough. A hole in the latter permits the rain-water to fill the slitted tube, so moistening the earth at the ground connection. No mention is made of anything in the way of a conductor further than the leader, which is not serviceable. Further, it is obvious that, if the lightning precedes the rain, the design fails of its purpose. As a matter of fact the old saying that "rain follows thunder" is a very true one.

Most of the patents exhibit, if not ignorance, at least a lack of confidence in Ohm's law. Preece's experiments have proved that discharges of the highest attainable intensity conform to the law. As a consequence, no advantage is to be derived from either flat or tubular conductors, conductivity alone being concerned. Faraday long ago pointed out this fact, and in this very connection. Most of the designs patented are poor. There is no originality, little ingenuity and a marked absence of anything calculated to give the impression that the inventors of lightning-rods have any thorough knowledge of the theory and use of lightning-rods. If we turn for a moment to the methods adopted by telegraph companies, electric lighting companies, and other large corporations to whom the question of protection from lightning is a matter of financial importance, we find a better understanding of the matter, and a confidence in their methods and devices, born from experience and knowledge.



Edison's device for protecting electric light systems from lightning consists of two conductors extending from each side of the external circuit to the earth. One is of high resistance and the other of low resistance. We insert in these two earth circuits an arrangement for controlling the low resistance circuit by the current in the high resistance circuit. A fusible wire is inserted in the high resistance, and an electro-magnet controlling a circuit-closer, acting upon cessation

of the current. In case of lightning, the closing of the low resistance circuit affords a ready ground. The total damage in such a case is the fusing of a few inches of fine wire. The illustration is interesting, because it shows the perfect obedience of lightning to known laws of electricity, and at the same time the facility and safety with which, in intelligent hands, currents of the greatest intensity can be handled.

In erecting a lightning-rod, the question of a good ground inevitably comes up. One or two inches of loose surface soil is not a ground. Further, connection with leaders or gutters, in the great majority of cases, is not a ground. No matter how much the question of a good ground is agitated, the erection of rods, which are decidedly not well grounded, goes bravely on. One of the most curious, or rather startling, instances of this is that of the Sorbonne (the great building of the French University). Sometime in the summer of 1880 six lightning-rods were put up. In September of the same year the building was struck by lightning. It then came out that the ground connections were defective, making rather a suggestive comment on the actual worth of the knowledge of the scientists and government officials, under whose supervision the rods were erected. Professor Tait tells of a British lighthouse, recently examined, where it was found that "the lower end of the lightning rod was *jumped* into the solid rock—a truly original form of earth." A well or spring, or flowing water, makes a good earth. A cistern or tank (non-metallic) is not an earth. A rule might be made to consider no earth good until tested. Lightning rods should be tested. The inspection of these rods is an industry yet undeveloped in this country. There is an ample field for work, and it should prove remunerative. In France this duty is performed by the government.

There is one final aspect of the question, not hitherto presented. The question of locality will determine to a great extent the use and nature of the rod. Places distant but a few miles from each other often differ greatly in the relative frequency of thunderstorms. In some localities the erection of rods is imperative, in others needless. Finally, the following further points should be regarded:

1. A solid galvanized iron rod should be $\frac{3}{4}$ inch in diameter, and a solid rod of copper at least $\frac{1}{2}$ inch. These are the best conductors.

2. No sharply bent corners or points should exist on the conductor proper.

3. The conductor should be as far distant as possible from metallic bodies not connected with the ground, or else connected with them.

4. The tops of the rod should be plated, or in some way protected from corrosion and rust.

5. Clusters of points, or groups of two or three, are advantageous.

6. Large trees in the vicinity, being efficient inductors, are of benefit, provided running water does not exist on the opposite side of the building.

7. Chain or linked conductors are of little use.

8. Painting will not interfere with the efficiency of the apparatus.

9. The conductors should not be insulated too well from the building.

CAMBRIDGE, MASS. ALEX. MCADIE.

THUNDERSTORMS AND AIR-PRESSURE.

The question of barometric fluctuations in the progress of thunder-storm action has already been touched upon many times in this JOURNAL, and is attracting much attention in Europe also. Some of the European meteorologists claim that by projecting isobars to each millimetre (.04″) they have found small subsidiary depressions which evidently accompany these storms. As the average velocity of LOW in the United States is less than 20 miles per hour, and as thunderstorms are known to frequently attain a velocity of 50 and 60 miles an hour, it is evident that the tracing of any such subsidiary depression will be of the highest interest, and may give important clews to the mechanism of the storm.

Thunderstorms may be divided into at least three general classes. 1st, common storms with light winds, more or less rain, and generally not very heavy thunder; 2nd, those preceded or attended by a characteristic high and sudden wind. This wind is *not* a shift from the gentle south or southeast wind that has been blowing, possibly all day, under the influence of a light barometric gradient toward LOW at the north, which gradient continues through the storm. Again it does not seem possible that it can be due at all to the suction of air into a subsidiary low, for if it were the first intimation we would have of it would be its great quickening

first from the east or southeast, then south, southwest and west. I have watched this wind again and again with the utmost care and with a wind vane and anemometer right before me, high above the influence of local disturbances. It makes its advance known nearly always by a tremendous cloud of dust reaching to the height of several hundred feet and extending as far as the eye can see north and south. The wind vane is jerked so quickly to the west or northwest that the eye must be kept continually upon it in order to catch it; at the same instant the anemometer begins a wild whirl reaching in a few moments three and four times the speed it had had for an hour or two previously. Everything indicates a wind propelled by a force from behind. Very soon there is heavy rain, sometimes a little hail, and heavy discharges of electricity. 3rd, those that may be termed electric storms, mostly experienced in the west, and of which but little has been written up to the present time. It was somewhat of a surprise a little while ago, to read a note from a thunderstorm observer, asking if he should record storms from which there was *no* rain. These have heavy electric discharges, with more or less wind but no rain. The latter is a most remarkable fact, and, if it can be substantiated, will go far toward disproving the theory of some that condensation and precipitation are essential to the production of atmospheric electricity. The latter class of storms should be most carefully investigated, as they bid fair to give important additions to our knowledge of these little understood meteors, in explanation of which many have called lively imaginations into play, and have built up beautiful theories that have fallen before the facts that have gradually come to light. There is no science that demands facts as does meteorology, and scarcely any division of meteorology that requires facts as much as that relating to thunderstorms.

The energetic manner in which the New England Meteorological Society has taken up this question is very encouraging, and bids fair to bring this subject still more effectually before the public. It may be that these three classes of storms, just mentioned, have entirely different fluctuations of air pressure, and hence there arises a necessity of recording such fluctuations minutely.

In order to plot the track of a subsidiary depression, if there is one, it would be necessary to have observations of carefully corrected barometers at stations near each other and having their altitudes well determined. A condition of things which can hardly be hoped for for some years to come. There is another method of

satisfactorily attacking the problem however. The following are the barometric oscillations, for each 5 minutes, during a violent thunderstorm that passed over Washington, D. C., at 1:50 A. M., April 26, 1885:

0h	55m	29″.885	1h	45m	29″.830	2h	35m	29″.845
1	00	.885	1	50	29 .850	2	40	.845
1	05	.885	1	55	.850	2	45	.840
1	10	.880	2	00	.855	2	50	.840
1	15	.880	2	05	.855	2	55	.840
1	20	.880	2	10	.850	3	00	.835
1	25	.880	2	15	.855	3	05	.825
1	30	.875	2	20	.855	3	10	.820
1	35	.850	2	25	.850	3	15	.815
1	40	.840	2	30	.845	3	20	.810

If a curve is traced from these records it will be found that there was a marked minimum at 1.45 and a maximum from 2.00 to 2.20. The heaviest and nearest claps of thunder, each a mile away, were at 2.20 and 2.25. There was scarcely any wind during the storm (7 miles from 1 to 2 and 5 from 2 to 3) and the rainfall was moderate. Now, it will be seen that if we have a sufficient number of stations in any region taking observations each 5 or 10 minutes, though we may not know the correction of the barometers or the exact heights, yet we can take the successive barometric fluctuations and study them for all the stations, and, what is more important, we can connect with these curves the wind, rain, hail, thunder, etc., of the storm.

For making such observations an aneroid barometer would be preferable to a mercurial as being the more sensitive and easier to observe, especially after dark, though either will answer. In reading the aneroid it is only necessary to tap the glass cover lightly two or three times with the finger-nail and reading immediately the hundredth of an inch, splitting if possible to .005. The time of the first observation should be carefully recorded, and afterward, if possible, a reading should be taken each 5 minutes. Observations should begin on the appearance of lightning in the distance, though the 5 minute readings need not be begun till either a sharp fall or rise begins, or thunder is heard. Note should also be made of the character of the storm, time of high wind, heavy rain and nearest or loudest thunder. Envelopes for forwarding any such special observations will be furnished any one who will send his address to the Chief Signal Officer, Washington, D. C. In this connection it may not be amiss to mention the exceeding importance of any and all barometric observations in the neighborhood of a *tornado.*

Persons having aneroids should by all means take them with them if driven to a place of safety, and should record readings as often as possible, keeping an eye on the needle continually for any very sharp fall or rise and recovery. A cellar or dug-out will give satisfactory results.

May 18, 1885. H. ALLEN HAZEN.

CLIMATE OF SANTA FE.

I. POSITION AND SURROUNDINGS.

Santa Fe lies in latitude 35° 41′ N, and in longitude 105° 57′ W. from Greenwich. Its latitude is nearly that of Nashville and Raleigh and is considerably greater than that of Los Angeles. In longitude it is a little west of Cheyenne. Its elevation is variously stated. Probably the most accurate is that determined by the railway engineers. According to this, the top of the rail at the station is 7019.5 feet above sea-level. The base of the monument on the plaza is 17 or 18 feet higher, making its elevation 7037 feet. The barometer of the Signal Service station, in April, 1885, was 11 feet lower, or 7026 feet. The elevation of the monument on the old Fort Marcy parade-grounds, as determined by the astronomers on Lieut. Wheeler's Geographical Survey was 7044 feet. The town itself climbs the surrounding hillsides and bluffs, and the elevation varies within the limits of the city. The altitude is great, and it must give the climate many characteristic features. There is no other station for regular meteorological observations in the United States at so great an elevation except Pike's Peak. Pike's Peak signal station is 14,134 feet above sea-level. The station on Mt. Washington is 6279 feet above the sea, or about 750 feet lower than Santa Fe. Pioche is 6110 feet in elevation, Cheyenne 6089, Prescott 5346, and Denver 5294. An effect of this elevation, which strikes the visitor at an early stage of his residence there, is the thinness of the air and consequent early fatigue on attempting any task greater than usual. The writer, within a few hours of his arrival, climbed to the location of old Fort Marcy, a bluff commanding the town and about 100 feet above it. He was surprised to find that, notwithstanding he considered himself a somewhat experienced mountain-climber, he was much blown and panted heavily on reaching the top. A little reflection convinced him that it was due to the rarity of the air. Probably the acknowledged

efficacy of a residence at Santa Fe in curing diseases of the lungs is, at least partly, due to this rarity of the air which compels the sufferer to expand his lungs more fully and take deeper inspirations.

The topographical surroundings of Santa Fe are picturesque and must have a marked effect on its climate. The town lies in the Rio Grande Valley. To the east runs an elevated ridge of the Rocky Mountains, coming down from the plexus of mountains in Colorado and Utah from which the great rivers Rio Grande, Colorado, and Missouri take their rise. The ridge to the east of Santa Fe is there called *the* Rocky Mts., and is probably the highest range in the mountainous territory of New Mexico. It extends northward through the county (Taos county) into Colorado. To the southward of Santa Fe it becomes somewhat lower, but it extends with more or less interruption into Mexico and runs out near Tampico. The Rio Grande passes through it on the southern borders of Texas, producing scenery of great picturesqueness and even grandeur.

Santa Fe lies at the western foot of this range. As one stands on old Fort Marcy one finds it running as far north as he can see. In the northeast is the highest peak, old Mount Baldy, not much surpassing, however, two peaks, though much higher than the neighboring mountains. Mt. Baldy* is 12,661 feet high. It is covered with snow except in the middle and latter part of summer. On the north and east sides it retains large masses of snow throughout the year. In a straight line it is nearly 15 miles from Santa Fe. By trail it is about 40 miles distant. It has been frequently ascended, and the trip takes three or four days from the town. A carriage can be taken for the first 20 or 22 miles and from there the entire ascent has been made, once at least, on horseback. The ascent is not dangerous, but is rather difficult. Near the summit are 3 or 4 deeply sunken lakes, possibly old craters. A little to the south of Mt. Baldy is Lake Peak, 12,405 feet high, so called because at its southern base is the lake from which the little Rio Santa Fe takes its source. East of the preceding is the "Cone," 12,690 feet high. The Santa Fe Creek flows southward about 12 miles, then turns westward and in about 9 miles reaches Santa Fe through which it passes. Its course is then southwestward, and it

* The Mexican name of Mt. Baldy is Jicarita, so called from a tribe of Apaches living formerly on the mountain in the summer time. These Indians are now located on the reservation of Tierra amarilla.

falls into the Rio Grande at the distance of about 25 miles from the town. Like similar streams in this region, Santa Fe Creek is given to suddenly disappearing. It disappears a few miles below the town, and remains concealed for a considerable distance. It also disappears for a short distance above the town. It is more important for the town than its size would seem to warrant. The town water supply and the fertility of the valley depend on it, and it sometimes swells rapidly and becomes so large as to carry away bridges and inundate a considerable territory.

Of the elevated mountains to the south of Mt. Baldy one sees but little from old Fort Marcy; they are concealed by the lower mountains and foot-hills, at the base of which the town lies. They are, however, from two to four thousand feet higher than the town. In them the Rio Pecos takes its rise, and it flows along their eastern flank. These mountains are well wooded, and on their sides is heavy pine timber along the Pecos and Santa Fe Valleys.

From Santa Fe the ground is rolling, but slopes gradually to the Rio Grande. The river at its nearest point is 21 miles distant, west, and a rivulet leads down to it from near the town. The plain between the town and river is much cut up by rivulets and presents a rolling appearance, and a little to the south of westward is a low range of mountains in this plain culminating in a volcanic peak with a crater called La Tetilla. The town is about 1700 feet above the Rio Grande at Peña Blanca.

To the west and on the horizon may be seen the Valles Mountains, on the opposite side of the Rio Grande. This is a mountain complex, full of isolated peaks and valleys, and in it are the Jemez Hot Springs. The mountains are from 25 to 50 miles distant and are not very elevated.

To the north the valley is cut off by spurs of the Rocky Mountains. A fairly clear horizon appears in the northwest. If one takes the road to the "Divide," 3 or 4 miles north of town, one sees a part of the open valley of the Rio Grande to the north, bounded far away in Colorado by an apparent cross range. The view from the "Divide" is a very remarkable one, extending down the valley of the Rio Tesuque. The valley is extremely rough and ragged looking, as if the result of one great torrent and not of the long continued action of water which leaves the rounded forms seen in the Santa Fe side of the "Divide." It reminds one much of the raggedness of some lunar landscapes when seen under unusually favorable circumstances.

To the south and southwest are three groups of mountains rising one above the other. To the southwest, and nearest, are the low Cerrillos Mountains, a celebrated mining region, 20 miles away. Farther away (about 30 miles), and a little farther to the south, are the Ortiz or Placeres Mountains, and still farther off (50 to 55 miles) rise above both the preceding the elevated Sandia Mountains. Many of these mountains are heavily timbered. To the southeast the horizon appears open.

Santa Fe thus appears to have an open horizon to the northwest and to the southeast. It is hemmed in closely on the eastern side and less closely to the north, while the mountains are distant on the west and south. The town is situated in a little fertile spot on the Rio Santa Fe. This stream is dammed about 3 miles further up, and from the reservoir thus made water is conducted to the town. The water is directly from the mountains, and being from springs and melted snow is remarkably pure and refreshing, and its head is such that it is said that water can be thrown 200 feet high on the plaza. The little river fails about the middle of June, just before the rainy season, but this need not interfere with the supply of water for domestic consumption, provided the reservoir is sufficiently large. This water-supply, one of the most excellent in all respects of any town in the world, is subject only to interference by floods. These may occur from too rapid melting of snow in the mountains in the spring or, more often, from remarkably heavy rains in the summer, in which cases there is danger to the reservoir and pipes, and the water may be turbid. This happened on August 9 and 10, 1883, when there was a heavy rain in the mountains, causing a serious flood and much damage at Santa Fe and over a large territory in the vicinity. The water-works were damaged and filled up with muddy water. The capacity of the water-works is said to be equal to the demands of 300,000 souls.

The country about Santa Fe is sandy and the character of the vegetation shows that it is dry. On the spot where the town is located is, however, a marshy tract—very welcome in so dry a place—and in the bishop's garden, just above the town, is a large spring. The vegetation immediately about the town is sparse. Flowers are infrequent, but those they have are often of brilliant colors and rich perfume. Two or three species of cactus grow there in low scraggy forms. One of them is the nopal or prickly-pear, the pear-shaped fruit of which is here small (about the size of a plum), but is good eating when the prickles have been

singed off. Cottonwoods grow along the streams, and on the plaza are some which are now over 40 years old (planted in 1844) and have attained a considerable size. Scrubby junipers (sabino) and pines (piñon) are common. The latter may attain a height of 15 or 20 feet with a diameter of trunk of 8 or 10 inches, when it furnishes a small nut, which is very much prized. Buffalo and gramma grass are found at no great distance from the town. Within a few miles, north and east in the mountains, are found spruces, and white and yellow pines which, under favorable circumstances, may attain a diameter of 3 feet or more, and may be 40 to 60 feet up to the first limb. Heavy pine timber is also found to the northwest immediately across the Rio Grande.

Good hunting is abundant in the vicinity of Santa Fe. Wild turkeys are common; also the black-tailed and red deer. Black bear are also found. The hunting grounds can be found within 20 miles, and nearer when the snow is on the ground. Grizzly and cinnamon bear are found in the Sandia Mountains somewhat farther off. There are small trout in the mountain streams. In the hills about Santa Fe, and even in its streets, may be found an abundance of that little lover of a dry, warm climate, the horrid-looking, but entirely harmless, and really useful, little lizard commonly called the horned toad. It is a voracious consumer of the smaller vermin, and I have it on good authority that one was seen to devour 70 ants in the space of a minute. They are oviparous, but, within a minute or two after the egg is dropped, the little animal makes its way out and scuttles off to care for himself. An interesting animal is the siredon, here called *guajalote*, celebrated among zoologists for the remarkable changes it undergoes. Nothing could be more harmless than it is, yet the Mexicans, especially the women, have a remarkable horror of it. Large trap-door spiders are occasionally found. Troublesome vermin are not very common. The adobe houses do not furnish many crevices to shelter them, and the nights are always rather too cool for great activity on their part. Rats are unknown on account of the elevation. The insect most complained of is the so-called "chinch-bug," the bite of which is considered quite venomous.

Although the soil appears barren, it really proves to be very fertile on irrigation. The mountain water is said to bring down large amounts of valuable fertilizers, among them the salts of lime and more especially gypsum. With water at command, it is easy to make the desert blossom as a rose. Where water can not be

obtained from mountain streams it is probable that it can be got by artesian wells, which have been successfully sunk in many places in Arizona, but have not yet been tried to any great extent in New Mexico. Wells are common in the town and have to be only from 10 to 40 feet deep. The water from them is rather hard. Out of the arroyos the depth would undoubtedly have to be considerably greater.

As it is now only about 15 per cent. of the region within a league of Santa Fe is cultivated. The fruits of southern Michigan and northern Ohio are produced without difficulty, and of a good flavor. Peaches, apples, apricots, pears, quinces, average well. Good plums are grown, but the Damson is not yet known there. Those grown are of fine flavor and large size. A few grapes are grown, but, so far, they are of a quality inferior to those grown farther down the valley. The summer is too short and cool for them to mature. Corn, wheat, barley, oats, beans, and peas do well. The corn is the small blue Mexican, or white pop-corn, or sweet corn. The season is too short and cool for the large Kentucky corn. The bean is a Mexican variety, large and yellow; it is not found in the eastern states. Onions do remarkably well, producing large crops and weighing each from one to two and a half pounds. The commonest domestic animal is the donkey, there called "burro." It is the usual beast of burden, and is in constant use as a pack-animal. The small western mustang, cattle, sheep, and goats do well. The native poultry is small and not attractive. Imported fowls have generally not done well, but could probably be acclimated with proper care.

The population of the town is about 6000. The county contained 10,867 in 1880, of whom 2 were Chinese and 359 Indians and half-breeds. The Indians are all of the pueblo or agricultural race, entirely inoffensive and, on the whole, honest and reliable. The dryness of the climate is shown in material prevalent for buildings—the adobe or sun-dried brick. They are made of valley mud, and, though they would not stand much water, there are adobe buildings in Santa Fe over a century old, and one is pointed out which is said to have been built more than two hundred years ago. They are in a fair state of preservation.

II. GENERAL CLIMATIC CONDITIONS.

The cyclones or storm-areas which traverse the United States from west to east generally give its various parts the weather that they have. The excessive precipitation of Oregon and Washington

is due to the advent of the cyclones from the Pacific heavily laden with moisture which is precipitated in front of the chilling elevations of the Rockies. The dryness of the plains east of the Rockies is largely due to the fact that the most of the moisture has been chilled out of the cyclonic areas by the high mountains, which, however, by collecting the precipitation and giving it off gradually, furnish a never-failing supply of water, thus giving the great rivers, the Missouri, Platte, Republican, Arkansas, Rio Grande, to plains otherwise dry.

As the weather depends, on the whole, on the cyclones we can get the best general view of the climate of Santa Fe, and of the territory in general, by examining its relations to these areas. For this purpose I have examined the *Monthly Weather Review* of the Signal Service from the middle of 1877 to the middle of 1883 (the year from July '77 to July '78 only lacking). In these five years 45 storm-areas have originated in New Mexico or have passed through or so near the territory as to affect its weather. This is less than 9 per year. The most of the states of the Mississippi Valley and Atlantic coast have half that number or more per month. About one-fifth of the cyclones first come in sight within the territory. Of the rest nine-tenths come from the northwest and pass out to the northeast. Those first appearing in the territory may have come from elsewhere and escaped observation until within its limits, but it is more probable that they originate about where they are found for the first time. They do not pass over Santa Fe; besides, as originating storms, they are mild and would gather energy as they proceed. They probably have little effect on the weather of the territory and none on Santa Fe.

A few have been aberrant, passing west instead of east. One came up from the Gulf, struck the southeast corner of the territory and disappeared in Lincoln county. Three came in from the northwest and then turned and passed into Arizona.

The northern half of the territory is much more frequented by the cyclones than the southern half. About three quarters of the cyclones crossed the northern to one quarter the southern half. Nearly all cyclones, coming to this region from the northwest, sooner or later make a turn in their path and go northeastward. This bend is frequently made in the territory; as often, perhaps, in Texas immediately east of the territory. It is quite rare for a cyclone to pass through the territory from northwest to southeast, and continue to the Gulf.

Only a few of the storm-areas come from the west, southwest and south,—perhaps 10 per cent. from these directions,—and these are for the most part confined to the southern part of the territory. By far the greatest number of those which affect Santa Fe come from some point between north and west. They must therefore pass over the great mountain plexus of Utah and Colorado, and, as they would be chilled and would condense their moisture, they must have precipitated the most of it before reaching Santa Fe. Hence arises the dry climate of Santa Fe and neighboring region, and, to a still further degree, that of the southern and western part of New Mexico.

This view is strengthened by the fact that the precipitation of individual storms is decidedly heavier to the northwest, in Rio Arriba county, than at Santa Fe. For instance, the storm of March 10, 1884, gave a very heavy snowfall to Rio Arriba county but produced only wind and hail with some rain at Santa Fe. Again during the winter of 1883–4 the precipitation at Santa Fe was not particularly remarkable, but in Rio Arriba county it was extreme, as the following notes, taken from the *New Mexican Review*, will show:

A little Mexican village known as San Antonito, had snow 25 feet deep in early April. There was no trace of the town visible, and it is described as a queer sight to see the blue smoke curling up through the white coating of snow with no sight or sound of life anywhere. The people entered their houses by snow stairways, and traveled only on snowshoes, crossing over tops of trees and houses and packing firewood from a great distance.

Col. Cummings' residence, in Eureka Gulch, is 70 feet long and has 25 feet from the ground to the top of the roof, and his barn is two stories high; yet not a shingle of these structures was to be seen and they could be passed over on snowshoes. The hard winter was an unusual one there, and, as it had been expected, cattle had been driven away in the autumn. At the same time there was little snow in Taos county, to the east, and in Santa Fe county, to the southeast. Other illustrations might be given. At the same time, as the storm-areas come often from a great distance, it will frequently happen that they are quite dry when they reach the northwestern corner of the territory, and, although that part is more blessed with precipitation from storm-areas than the rest, yet it is not itself a region of great precipitation.

Rain and snowfall from cyclones passing Santa Fe is slight. In other respects the cyclones passing over it are much the same as elsewhere. The succession of winds appears to be the same, notwithstanding an elevation greater than that of Mt. Washington. This, of course, is to be expected, as the observing station here is not a point elevated far above the surrounding country, as it is at Mt. Washington, but is on the surface of an elevated valley. The cloudiness connected with the storm area is little pronounced. It does not usually develop into an extended stratus-layer, but consists rather of cumuli and cumulo-strati.

Another feature, and one of considerable interest, is that the passage of storm-areas over Santa Fe is not evenly distributed through the year, but is much more common in the dry than in the rainy season. The wet season begins there in June or July and continues through August. On the other hand the cyclones are most common in the dry season. From November to April, inclusive, the number of cyclones affecting New Mexico, in the period examined, was 33; from May to October, the number was 12,—making nearly three times as many for the dry as for the wet season. In June, July, and August there were six cyclones; in December, January, and February, there were 17. The interesting fact appears, then, that the wet season at Santa Fe is not due to general storms. As a matter of fact, it is well recognized there that the precipitation is due to local storms. Any resident will tell the inquirer that the rain comes with thunderstorms which are likely to come on in the afternoon after a sunny morning, give a smart shower and then disappear, leaving the sky again clear. The character of these storms will be more fully discussed hereafter. It is sufficient here to call attention to the fact that the chief precipitation depends on local storms and that it is to them that the country owes its inhabitability. Were it not for them, that part of the territory would be a desert indeed.

III. GENERAL DETAILS ON THE CLIMATE.

The individual features of the climate are due to the elevation, the mountainous surroundings, and the latitude of Santa Fe. The barometer reads on the average 23.26 inches, and requires a correction of about 6.75 inches to reduce it to sea level. It varies but

little from year to year as the following mean readings of the Signal Service will show. They are the annual means.

Year.	Annual Mean.	Year.	Annual Mean.
1872	23.292	1878	23.251
1873	23.272	1879	23.299
1874	23.211	1880	23.269
1875	23.209	1881	23.268
1876	23.256	1882	23.238
1877	23.263		

The normal monthly values, corrected for temperature and instrumental errors, from observations at 7 A. M., 3 P. M., and 11 P. M., Washington mean time, from Nov. 1, 1879, to Oct. 31, 1881, as accepted by the Signal Service, are as follows:

Month.	Mean.	Month.	Mean.
January	23.172	July	23.337
February	23.165	August	23.325
March	23.131	September	23.295
April	23.206	October	23.283
May	23.209	November	23.221
June	23.250	December	23.169

The maximum pressure occurs at Santa Fe in mid-summer and the minimum in spring, nearly the reverse of the usual order. The range of the barometer is also small. In the monthly values above given it is only 0.206 inch. The average for the year of the daily barometric range, for the period during which observations have been carried on at Santa Fe (11 years to 1883), is 0.53 inch. This is small, as is usually the case in the southern part of the country. It is even smaller in Arizona, at Phœnix 0.45, Florence 0.42, Camp Thomas 0.34. It grows very large in the extreme northeast and northwest, being 1.10 at Portland, Maine, 1.18 at Eastport, 1.21 at St. Michaels, Alaska, 1.27 at Sitka, and 1.54 at Unalashka. Its climatic meaning is the changeableness of the weather. When it is small the weather is uniform, when large, changeable. At Unalashka they have more "weather" per day than at any other recorded station in the United States. When these figures are small the climate is, in so far, suitable to persons

sensitive to weather-changes—as those afflicted with diseases of the respiratory organs. These figures are low for the southern United States, but average lower for the southwestern portion, west of Texas, than elsewhere.

The mean temperature of Santa Fe from 1872 to 1883 (ten years, 1882 omitted, as the observations were incomplete) is 47°.9. This is about the same as that of Boston (48°.3), Albany (48°.1), Buffalo (46°.8), Detroit (48°.1), Grand Haven (47°.2) and North Platte (48°.0). The isotherm of 48° strikes nearly north from Santa Fe along the eastern side of the mountains through Colorado. It then strikes eastward, and, making a bend to the south, crosses the southern end of Lake Michigan, runs the length of Lake Erie and strikes the coast on Massachusetts Bay. To the west of the mountains it passes nearly northwest, coming out near Puget Sound. This isotherm has therefore a large southern extension along the Rockies, and at the very angle of that extension, where it turns northward on both the eastern and western sides, lies Santa Fe. It is cooler than any other station of the same latitude in the United States, and cooler than most stations with a latitude less than 41° or 42.° It is at the extreme southern point of the cool region of the United States. To the north one would have to travel to British America before he would reach a station with an average temperature 10° lower; to the south one could easily find a change of 15° in annual temperature on the Rio Grande and within the territory. The annual temperature has but a slight change from year to year as may be seen below from the figures of the Signal Service:

Year.	Annual Mean.	Year.	Annual Mean.
1872	47.9	1878	47.5
1873	48 6	1879	50.2
1874	48.0	1880	45.4
1875	48.0	1881	lacking
1876	47.5	1882	48.3
1877	47.6		

The normal monthly values will show the distribution of temperature through the year. From 1871 to the end of 1882, they are as follows:*

* These and the figures preceding and following are taken from the Signal Service Reports, from the most part, from that of 1883.

Month.	Mean.	Month.	Mean.
January	28.2	July	68.0
February	31.7	August	65.9
March	39.1	September	59.0
April	45.5	October	49.4
May	56.0	November	36.7
June	65.4	December	30.2

From this it appears that Santa Fe is relatively warmer in winter and cooler in summer than other places, having nearly the same annual temperature. This will appear by comparing the difference between the coolest month and the warmest month for these places: In Santa Fe the monthly range is 39°.8. in Boston 45°.1, Albany 49°.4, Buffalo 44°.8, Detroit 46°.6, Grand Haven, 43°.7, North Platte 52°.3. Comparing by seasons (with the aid of Denison's Climatic Maps), we find that Santa Fe has the spring temperature of northern Illinois and Indiana, the summer temperature of northern Wisconsin and Michigan, the autumn temperature of central Wisconsin and Michigan, and the winter temperature of central Illinois and Indiana. In other words, by staying in Santa Fe the invalid gets the favorable summers that a resident of Springfield, Illinois, only gets by migrating annually to Lake Superior.

But while the monthly range of temperature is favorable for Santa Fe, the daily range does not look so well. The average of the difference between the maximum and minimum temperature for each day of January, 1881, at Santa Fe was 23°.0. For Boston it was only 17°.6, for Buffalo 14°.1, and for Detroit 11°.4, though for North Platte it was larger, being 24°.8. For July the figures in the same order were, 23°.2, 19°.0, 13°.4, 20°.2, and 22°.6. The average daily range was smallest for Santa Fe in November, when it was only 16°.5. It is thus seen that the daily change of temperature is somewhat larger in Santa Fe than in places of corresponding mean temperature in the eastern states. Santa Fe approaches in this respect the Californian stations, in some of which the diurnal change of temperature is much more sensible than the annual change. In Santa Fe, however, this disagreeable characteristic is not so marked as in places farther west. It only goes so far that, whatever the temperature of the day, the nights are sure to be cool. It is probably largely due there to the clearness of the sky which permits the nocturnal radiation to lower the temperature during the night with little or no interruption by clouds.

As to extremes of temperature, the lowest I have found on the records is −13°. The thermometer reached this point in December, 1879, and in January, 1883. The highest record found was 95°.5 in July, 1878. This is a remarkably low absolute maximum for the southwest. In Arizona stations the absolute maximum is never below 100°, and at one station reached 118°. At San Diego the thermometer has reached 100°. In no station whose records I found in New Mexico did the absolute maximum fall below 100° except at Silver City, and there the record is 99°. At Galveston it is 98°.5. For eleven years the highest and lowest temperatures at Santa Fe for each month are as follows:

Month.	Highest.	Lowest.
January	76°	−13°
February	75	− 3
March	82	0
April	84	11
May	89	24
June	92	33
July	95.5	46
August	97	40
September	90	27
October	85	16
November	77	−11
December	65	−13

These are the figures for the observing station which is somewhat elevated. Close to the ground, in clear still weather, the temperature at night would be lower. In fact, a frost was reported in 1883 as late as June 9, and in 1882 on June 13. It has already been noted in the city that the seasons vary in different parts. The place is very uneven and the season, as might be expected, is earlier in beginning and later in ending on the more elevated parts. Within a short distance of Santa Fe this difference, in the date of latest frosts, has been found by experience to be as much as two weeks.

The precipitation is small and variable. The observations extend from 1862, when they were begun by the surgeon of the army post. They are somewhat incomplete, and the annual values, when they could be obtained, are as follows:

Year.	Inches.	Year.	Inches.	Year.	Inches.
1863.....	8.21	1871.....	14.62	1877.....	13.15
1864.....	18.11	1872.....	9.87	1878.....	19.52
1865.....	16.95	1873.....	9.73	1879.....	11.44
1868.....	8.96	1874.....	19.93	1880.....	9.89
1869.....	11.57	1875.....	18.97	1882.....	11.37
1870.....	14.02	1876.....	15.07		

The annual average for the seventeen years is 13.61 inches. It will be noticed that the rainfall was unusually large from 1874 to 1878. It was also unusually large in 1864 and 1865, and although I have not the records, yet the testimony on the ground is so unaminous that there is no doubt that the rainfall has been unusually large in 1884 and so far in 1885. Mr. Samuel Ellison, the territorial librarian, who has been in the territory for 38 years, informs me that there was also a period of relatively heavy rains about 1852. These figures make it probable that there is a periodicity in the rainfall, with a period of about 11 years,—so far apparently rather shorter than the sun-spot period.

The mean distribution of precipitation through the year, for the ten years observations of the Signal Service, is as follows:

Month.	Amount.	Month.	Amount.
January.....	0.53 in.	July.....	3.41 in.
February.....	0.61	August.....	3.01
March.....	0.52	September.....	1.25
April.....	0.61	October.....	1.02
May.....	0.85	November.....	0.91
June.....	1.14	December.....	0.65

The rainy season is seen to include all the months of July and August and parts of June and September,—making about three months in all. In the two months nearly half of the precipitation of the year comes down, and in the three full months of the rainy season decidedly more than half. During the remainder of the year the precipitation is very fluctuating. It often happens that for an entire month there is not sufficient rain or snow to measure. The number of days on which rain falls in the year are about 60, snow about 30. That is, a larger or smaller amount of precipitation is likely to fall one day in three. But the amount is often very small, sometimes only a few drops; sometimes, however, the

rainfall is unusually large. On the 20th of July, 1868, between 12 noon and 12:30 P. M., 1.6 inches of rain are recorded. This was with a violent thunderstorm; indeed the summer rains are thunderstorms or of that type of storms. The snow at the level of Santa Fe is usually confined to the months from October to May inclusive. On the mountains it is frequently seen in other months and may be seen in any month. Sometimes the snowstorm creeps down the mountains as far as Santa Fe in the summer months. This is a rare phenomenon, and the snow that falls at this time is slight and disappears at once. As illustrations of untimely snows we may instance one well remembered by the citizens, viz.: July 4, 1876, when a slight snow fell. Hail sometimes falls in the summer with rain, but is rarely or never destructive. Dew and hoarfrost occasionally occur, but they are very infrequent, always light, and disappear so early that most residents never see them. When the dew falls it is at the end of the rainy season. Though it is not abundant at Santa Fe it is a common phenomenon at no great distance, both at lower and higher elevations. Twenty-five miles to the southward heavy dews are not rare, and farther down the Rio Grande, on the Mexican side, as at Comajo, the dews are exceptionally heavy.

It is a curious fact that at Santa Fe the relative humidity does not average higher in the two months of the wet season than in some of the dry months. The average relative humidity, for the years of the Signal Service observations, is:

Month.	Relative Humidity.	Month.	Rel. Hum.
January	51.8	July	46.5
February	54.3	August	50.9
March	42.4	September	43.5
April	35.2	October	41.9
May	30.3	November	49.2
June	30.5	December	50.7

January and February are moister than July and August, though the former are in the dry, and the latter comprise the most of the wet season. This is of course due to the annual variation of the relative humidity, which is the reverse of that of temperature. The average annual humidity is 43.2. This is very dry. The relative humidity of Boston is 69.2, San Diego, 73.2, Buffalo, 73.1,

Detroit 71.4. None of these places are considered damp. Olympia is a good illustration of a damp climate, and there the relative humidity is 79.2. The other stations in New Mexico are not so dry as Santa Fe. Silver City has a relative humidity of 49.4, and El Paso, over the line in Texas but fairly typical of southeastern New Mexico, has a relative humidity of 50.9. In Arizona it is often drier. At Tucson the figures are 42.5.

Santa Fe lies in the driest portion of the United States. This region is extensive, but changes its form from season to season. Santa Fe is always in it, however, and it is always possible to pass out of it into a moist island by going a few miles north or northwest. In spring this region embraces New Mexico, Arizona, Nevada, a part of California and small parts of the adjoining states and territories. In summer it embraces the same territory, but has enlarged its borders, extending northward to the British Possessions and embracing Utah, the most of Colorado, Wyoming and Idaho and a large part of Oregon. In the autumn it shrinks to its spring dimensions with the addition of a broad arm running up east of the Rockies into Wyoming. In the winter it withdraws from the most of Nevada, but increases somewhat in the northeast, occupying a large part of Colorado and some of Wyoming. In all seasons it holds firmly on Arizona, New Mexico, and southeastern California and Nevada. A curious moist island is however always found in the mountains north and northwest of Santa Fe, occupying Rio Arriba and Taos counties in part and extending far into Colorado. In Denison's maps another moist island is found in Arizona in the vicinity of Camp Thomas, on the Gila River, in Graham county. The cause of the first island has already been indicated (in the first part of this paper); the reality and cause of the latter would be an interesting subject of study.

The cloudiness at Santa Fe is slight. It is a region of general sunshine. The average cloudiness for the year is about one-third. In the dry months it falls to a quarter or a tenth, and falls short of an average of half overcast even in the cloudiest months. The clouds are most abundant in the afternoon and early evening. The nights and forenoons are generally clear. The sky is rarely entirely overcast. The clouds are rarely of the blanket or stratus form; they are usually cumuli or cirri, or some of the intermediate forms. The cloud-formations are particularly pretty there, and form a never ceasing and always varied panorama for those who are accustomed to cast their eyes upward. The number of clear

days per year, that is days when the sky is not more than a quarter cloudy, average 145. The number of days when the sky is more than three-quarters cloudy average only 35. All other days than the latter may be fairly called sunny days, and in that case it appears that 11 days out of 12 are sunny. The clearest weather occurs in the autumn and early winter, particularly in October and November, the cloudiest in late spring and summer. The sky, however, is not as brilliant as might be expected from such a record of cloudiness. In April and May, when the writer was there, he found the sky no more brilliant, nor the stars brighter than in Chicago or Ann Arbor. Indeed the twinkling of the stars, the astronomer's ready test of bad seeing, extended usually from horizon to zenith, and it was not easy to see stars of the sixth magnitude. This is doubtless due to the proximity of the mountains, and it is probable that it is not so bad in the autumn.

In the winds of Santa Fe there is nothing especially notable. The average monthly movement is 5,095 miles, making an average velocity of about 7 miles per hour. The average movement is greatest in April, when it reaches 6,090 miles. As April is near the end of the dry season, the increased wind velocity drives the dust with some force and makes the month a dusty and relatively unpleasant one. The smallest is in September when the average for the month is 4,281 miles. The average movement given above (5,090) is near the average for all stations in the United States. In many individual stations the velocity is twice as great (Block Island, 10,789, Hatteras, 11,552, Portsmouth, N. C., 11,206) and on Pike's Peak it is nearly three times as great (14,856). The movement at Detroit is 5,542, Boston 6,630, Florence, Arizona, 2,140, La Mesilla, N. M., 1,721. High winds are not very common at Santa Fe, 35 miles per hour is rarely surpassed.

The winds come more often from the southwest than from other directions, though this wind does not prevail to the extent that it does in the Lake Region and Upper Mississippi Valley. The southwest winds are especially common in spring. In summer, the winds here have a more eastward tendency, and in autumn and winter a more northward one.

The "Northers" are occasionally felt in the autumn and early spring. They are, however, infrequent and are always mild. The cold winds are usually from the southwest, but the breezes from the mountain snows sometimes deserve the name of "cold."

(*To be continued*). M. W. HARRINGTON.

THE COLD WEATHER OF FEBRUARY AND MARCH, 1885, AT THE NEW YORK METEOROLOGICAL OBSERVATORY.

During the past two months the cold weather has been of unusually long duration; so much so that in many places in and about the city the water and gas pipes, which are placed about four feet under the ground, have been frozen. This being the case, I have thought that it would be interesting to see from the records of Draper's continuous self-recording thermometer of this observatory, what was the difference in the duration of the cold in this year as compared with last. The following table shows the comparison of temperature every ten degrees from the lowest to the highest, for the years 1884 and 1885 during the months of February and March, and also the number of times or hours the temperature was below or above 30 degrees, which has been taken as a temperature of neither freezing nor thawing:

Degrees.	1884. Hours Duration.		1885. Hours Duration.	
	Feb.	March.	Feb.	March.
—10 to 0	0	0	2	0
0 to 10	14	11	44	5
10 to 20	30	71	191	139
20 to 30	97	105	250	157
Hours of cold	141	187	487	301
30 to 40	375	223	155	362
40 to 50	152	225	30	62
50 to 60	28	102	0	19
60 to 70	0	7	0	0
Hours of heat	555	557	185	443

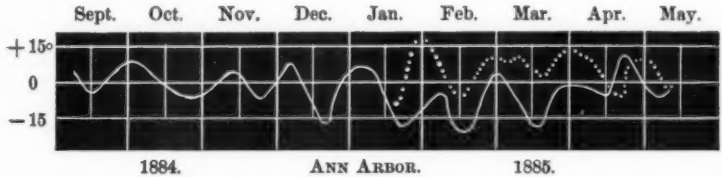
Hours of cold in 1885 for Feb.	487	
" " " " " " March.	301	788
" " " " 1884 " Feb.	141	
" " " " " " March.	187	328
Difference of hours of cold between the two years		460

There were, therefore, during these two months 460 hours more of cold in 1885 than in 1884.

Daniel Draper, Ph. D.,
Director.

A TEMPERATURE OSCILLATION OF SHORT PERIOD.

The accompanying curve was constructed from numbers obtained by getting the mean temperature of every ten days at Ann Arbor, Mich., from September to May, and subtracting these means from the normal temperatures of the times for which they were obtained. The normal temperatures were obtained by interpolation: thus, the average temperature of March was supposed to represent the normal temperature of the middle of the month; likewise the average of April was supposed to be the normal of the middle of the month, and there was supposed to be a uniform rise from one to the other. This is not rigorously correct, but the variations from the truth must be very small in comparison to the large temperature changes dealt with; and, besides, the supposition of a uniform change in obtaining the normals is probably an advantage in the problem with which I am dealing, as will be seen farther on.



It is only necessary to glance at the curve, to notice the remarkably regular oscillation which has taken place in the temperature, each oscillation occupying about 30 days in its completion. In November and April the regularity is broken, but otherwise the crests of the oscillations have occurred almost exactly a month apart. Similar and *coincident* oscillations were found as far east as Boston, and as far west as Montana; but the temperature at Salt Lake and El Paso showed no indications of the oscillation; and it is probable that beyond a line drawn through these two places the temperature oscillated similarly to the Ann Arbor oscillation, but oppositely in phase. The curve for Helena, Mon. from January to May (the only time for which I have continuous data) is represented on the diagram by the dotted curve. The oscillations are seen to be coincident with those at Ann Arbor until the latter part of April, when the curve at Ann Arbor began to oscillate in a

reverse direction. A marked difference between the two, however, occurs in the fact that the temperature was almost continuously above the normal at Helena, and almost continuously below at Ann Arbor. This was due to a slow moving cold wave of long period, (pointed out in the April Number) which was central in Montana in December and in the Lake Region in February, followed by a warm wave which was central in the vicinity of Montana in March.

The shorter oscillations are possibly connected with, and an extreme development of, those recurrent periods of heat and warmth which have been found to occur at certain times of the year in some countries. Buchan points out six cold periods in England, five of which occur a short time before the middle of five separate months.

Pressure oscillations were found in the United States coincident with those ofthe temperature.

I discovered these regular pulsations of the temperature about the first of March, and the oscillations being so great as seemingly to override other influences, I thought a prediction might safely be based on them without taking the others into consideration.* Accordingly I wrote in a letter to the editor, dated March 19, which was published in the April JOURNAL, that "If I should hazard a guess as to the coming weather in the Lake Region, I should say—a period of considerable warmth during the first part of April,—a cooler period about the 15th to the 20th, and warm again during the first of May." It will be seen from the curve that the temperature rose to the first part of April, and sunk toward the middle; but the maximum which was expected to occur about the first of May was pushed so far foward as to make the latter part of the prediction a complete failure. In April I accepted an invitation to try another guess for May, but when I came to make up my prediction on the 24th, I saw the temperature had risen much more rapidly than expected; and fearing what actually did take place, viz., that the temperature oscillation in the Lake Region was being reversed, and that a minimum

* I do not seem to have made my position understood, since it was stated in the May No. that Mr. Sherman and I would undertake weather predictions; and that 'the principle on which the predictions will be founded is that laid down by Mr. Sherman in his article on page 248 of the last volume.' This, however, does not fairly represent my position, I hold in common with Mr. Sherman that there are weather changes of long period which have an eastward movement, but I hold that there are frequently,if,not continuously, weather areas of greatly varying rates of movement and duration existing over the United States at the same time; and besides I hold that there are recurrent oscillations in the pressure, temperature, and rainfall which take place independent of motions of translation.

might occur during the first part of May, and a maximum during the latter part, I concluded not to attempt any details but only give what I thought would be the general tendency of the month, on account of the slow eastward movement of the area of warmth. The editor has kindly opened his pages to Mr. Sherman and myself; and I shall continue these attempts at forecasting, not because I can hope for a high degree of success at first, but because I believe that I will be able to attain a higher degree of success than can be attributed to chance—notwithstanding the fact that the data accessible to me in time to be utilized as a basis for prediction is comparatively meagre, and the amount of labor which I am able to perform necessarily limited—and thus add another link to the chain of evidence by which I shall not only attempt to prove the existence of systematic weather changes of long period, but the practicability of utilizing them in weather prediction.

With this aim I shall make my predictions as exact as possible, so that they can be submitted to scientific tests.

H HELM CLAYTON.

LITERARY NOTES.

(10) **Meteorologische Zeitschrift.** Redigirt von Dr. W. Köppen. Berlin, Januar, 1885.

E. HOPPE: Ueber atmosphärische und Gewitter-Elektricität; 1–10. This will be noticed when completed in a later number.

W. KÖPPEN: Zur Charakteristik der Regen in NW-Europa und Nordamerika; 10–24. A statistical study of the absolute probability of rain (rain observations divided by total observations), the mean duration of rain in a day for every month (the same, multiplied by the number of hours in a month and divided by the number of days with rain), and some other factors, chiefly for Norway (1874–78) and the United States (1877). The absolute probability for New England has its maximum in March(.226 — March, 1885, would give a very different result) and minimum in September (.037). The mean duration for N. E. has maxima in March and October (8.7 and 8.6 hours) and minimum in August (2.8).

S. TROMHOLT: Zur Geschichte des Nordlichts; 24–27. Extracts from old writings concerning the visibility of the aurora in Norway.

K. WEIHRAUCH: Ueber die Abweichung eines frei fallenden Körpers von den Vertikalen; 27–29.

W. KÖPPEN: Die Bildung von Bodennebeln; 30. Low-lying fogs imply stability of atmosphere, with warmer air at a moderate altitude than on the ground; this is contrasted with the formation of clouds and rain, which generally depend on ascending currents resulting from unstable equilibrium.

—— Die alte Frage nach dem offenen Polarmeer; 30–32. Reviews articles by Ray and Woeikof in *Science* (Sept. 26, Nov. 28, 1885), and mentions alleged discovery of relics from the "Jeannette" on the east coast of Greenland.

A. RICHTER finds a faint secondary maximum for thunderstorms at two to three o'clock A. M.; and also a persistent increase of frequency during the first four hours after the moon's upper culmination.

W. KÖPPEN comments on the latter point, regarding it as an important one for further study, but not feeling convinced of its proof. W. M. D.

(11) **The American Journal of Mathematics.** Vol. VII, Number 3, April 1885, pages 197-292. Baltimore. This quarterly is now edited by Professor S. Newcomb, and is apparently growing thicker with each issue. This number is polyglot, having one article in German and two in French. The contents are purely technical, but of very high value. The publication is indispensable to American mathematicians. H.

(12) **Quarterly Journal of the Royal Meteorological Society.** Vol. X, No. 52, October, 1884.

A. T. WISE: Meteorological observations on the Maloja Plateau, Switzerland; pp. 213–217. Observations of the temperature, moisture, wind and rain are discussed with special reference to the physiological effects of climate and the value of this locality as a health resort.

A. N. PEARSON: Barometric variations in western India; pp. 219–236. Presents an apparent cyclic oscillation in barometric abnormals. The traces of quarterly abnormals are thought to indicate the existence of a yearly double oscillation. Out of 12 years there are only four failures of symmetry, and these failures themselves are found to be cyclic, occurring every third year. These barometric movements appear in advance in

the south during the first and fourth quarters of the year and in the north the second and third quarters. The abnormals were largest in 1877, since which time the amplitude of the oscillation has gradually become smaller until it has nearly faded out.

R. H. SCOTT: The equinoctial gales. Do they occur in the British Isles? pp. 236–240. No strongly marked maximum of storms is found at either equinox. The autumnal equinox immediately precedes a maximum of storm frequency and the spring equinox is marked by a large diminution in frequency.

R. ABERCROMBY: On the physical significance of concave and convex barographic or thermographic traces; pp. 241–249. With a falling barometer the trace is convex for an increasing rate and concave for a decreasing one, for a rising barometer the reverse.

With reference to storms the author concludes: A convex barogram is always a bad sign with a falling barometer and a good sign with a rising one; a concave trace is sometimes a good sign with a falling barometer and not always a bad indication with a rising one. The flexure of thermograms depends similarly on the rate of thermal change.

C. HARDING: Maritime losses for 1883; pp. 250–253. A list of wrecks and storms.

W. G. BLACK: Climate of the delta of Egypt in 1798–1802; 253–261.

REV. J. BRUNSKILL: The Helm wind; pp. 267–269. Additional historical notes are appended. The peculiarities of this remarkable wind are attributed to the unusual topographical features of its locality—Cross Fell, Cumberland.

J. W. TRIPE, M. D.: On some relations of meteorological phenomena to health; pp. 276–281. The relations to health and disease of the different meteorological elements are carefully analyzed, both separately and in their combinations.

W. MARRIOTT: Some occasional winds, and their influence on health; pp. 290–294. A compilation of the more noted local winds and their peculiar characteristics.

And other papers. G. E. C.

(13) **Symons' Monthly Meteorological Magazine.** February and March, 1885.

V. RAULIN: Distribution of Rain in Jamaica; pp. 1–3. The author divides the island into four *régimes* according to the character of the seasonal rainfall.

Is the Rainfall of Kansas increasing? pp. 6, 7. The editor reviews Prof. Snow's discussion and remarks that experience has shown the difficulty of being sure that rainfall differences, like that given by Prof. Snow, are real and not due to a difference of exposure and similar changes.

Penthemeric Tables; p. 8. Mr. J. H. Hill notes the value of five-day tables for the study and discussion of rainfall.

Denton's Unchangeable Thermometers; p. 11. It is claimed that by a special process in construction these thermometers suffer no change in their index error through age.

Rainfall of Cape Colony; p. 19.

V. RAULIN: Distribution of Rain in Mauritius, pp. 19–20.

The New Time; pp 22, 23. The attempt to introduce into daily use the "new time," by which the hours shall be counted from 0 to 24, is said to have entirely failed. G. E. C.

(14) **Meteorologische Zeitschrift.** Redigirt von Dr. W. Köppen. Berlin, Feb., 1885.

ASSMANN: Mikroskopische Beobachtung der Wolken-Elemente auf dem Brocken; 41–47. Direct observation gives no evidence for the vesicular theory of cloud particles, even in drops having diameter of only $\frac{1}{1\,1\,5}$ to $\frac{1}{2\,5}$ mm. A review of the vesicular theory is presented, with the conclusion that the better judgment of physicists is against it.

ARCHIBALD: Bericht über einige vorläufige Experimente mit an Drachen befestigten Anemometern; 47–52. (See this JOURNAL, vol. I, p. 374.)

ROTH: Ueber die Divergenz des durch einen Wassertropfen gespiegelten und gebrochenen Lichtes; 52–62. An optical investigation of the effect of spherical particles (not vesicles) of water on parallel waves of light, by reflection and refraction.

SCHAPER: Beschreibung der erdmagnetischer Station zu Lübeck; 62–70.

KIESSLING: Zur Erklärung der ringförmigen Gegen-Dämmerung; 70–72. At sunset and sunrise, a colored ring similar to that which for the past year has surrounded the sun, has occasionally been seen *opposite* the sun. Kiessling concludes that it is produced by diffraction in light reflected from nearly equal sized water particles; this may be seen experimentally by throwing parallel rays of light from an electric light on a glass vessel containing homogeneous mist (see *Meteorologische Zeitschrift*, i, 119).

V. DANCKELMANN: Die meteorologischen Beobachtungen von Dr. Pogge in Mukenge; 72–75. Statistical. The rains are found to increase not only in going toward the equator, but in going inland from the coast. At Loanda, the dry season is five to six months long; on the lower Kongo and in Loango, four to five months; at Mukenge, one to one and one-half months. Violent thunderstorms come from the east, with winds blowing outward from the centre. A single mention of the great sunsets is made on August 28, 1883.

ESCHENHAGEN: Beeinflussung der magnetischen Registrirapparate in Wilhemshaven durch das Erdbeben in Spanien am 25. Dezember, 1884; 76–77. The instrument for measuring vertical intensity, Lloyd's magnetic balance, was set vibrating about 11.4 minutes after the earthquake. A similar disturbance was felt in magnetic instruments in London (*Nature*, Jan. 22), 7.0 minutes after the shock. The distances to the points are 2,040 and 1,650 kilom. respectively.

W. M. D.

(15) **E. Durand-Gréville.** Les cartes nautiques. *Revue scientifique*, 1885; 71–81. General description of nautical wind charts, especially of those by Lieut. Brault of the French marine.

G. Mouneyrès: Remarques sur la théorie des cyclones et des tempêtes. Id. 244–246. Likens the path of an air molecule in a progressing storm to that of the moon revolving about the advancing earth. Regards barometric depressions as "the immediate result of the rotation caused by electric currents," and accepts Fayes theory of storms with descending vortices. W. M. D.

(16) **Annual Report of the Department of Marine and Fisheries** for the year ending June 30, 1884. Ottawa, Can. Appendix No. 30 is a report by the Meteorological Office, of Toronto, of the Hudson Bay expedition under command of Lieut. A. R. Gordon, R. N., 1884.

Appendix 31 is a brief annual report of the Meteorological Service of the Dominion for the year ending Dec. 31, 1884.

(17) **A Condensed Statement of Met. Observations Made at Sandwich, Ill., During 33 Years,** lat. 41° 31′, lon. 88° 32′, height 690 ft. above sea-level, by Nahun E. Ballu, M. D., Ph. D., F. R. Met. Soc.; 1 p.

(18) **Ellery:** Notes on the Rainfall map recently issued by the Government of Victoria; Roy. Soc. Victoria, Trans. xx, 1884, 121–123. Notice of a map printed in nine grades of blue, and showing fall from under five to over fifty inches for 1882. An annual issue is contemplated.

H. C. Russell: Rainfall map of New South Wales for the year 1883. Journ. Roy. Soc., N. S. W., xviii, 1884. Rainfall for numerous stations indicated by circles whose diameter is proportionate to the fall. On both of these maps the rain is heavy on the coast slopes, and light in the interior. W. M. D.

(19) **J. Platania:** Le typhon du 7 Octobre 1884 à Catane, en Sicile. *La Nature*, 1885, 97–98. A tornado passed near Catania, Sicily, at 12:30 P. M., Oct. 7, 1884, exhibiting a well marked funnel

cloud, rotating from right to left, moving E. N. E. over a narrow track 27 kilom. long. It caused much destruction of property, killed 27 persons and wounded about 500. Two illustrations are copied in *Science* for April 2, where, as in *La Nature*, this storm is unadvisedly called a "typhoon." W. M. D.

(20) **E. Vimont:** Le tornado de l'Orne. *L'Astronomie*, 1885; 147–152. At 3 P. M. Feb. 16, 1885, a tornado swept over part of Normandy, moving to the northeast, and advancing 8200 meters in ten minutes; there was heavy rain and thunder, and about 500 trees were blown down.

Julia Braddon: Six trombes marines observées dans l'espace d'une demi-heure. Id., 110–111. Gives good figures of a number of waterspouts formed on the Mediterranean at San Remo, at 10:45 A. M., Jan 13, 1885. They appeared beneath dark clouds on a quiet sea, in a moderate southeast wind; a peculiar bushy mass of spray marked the spot where the spout rose from the water surface.

(21) **Annalen der Hydographie:** 1885 Zwei Taifune in Japan am 15 und 17 bis 18, Sept. 1884; p. 99–101. Account of two typhoons that crossed Japan last September, giving details of wind observations.

Die Wetter Telegraphie-und das Wetter in Japan 1883-84; 89–99. A number of climatic summaries are given; three valuable plates illustrate the rainfall for the year, and the tracks of cyclones and anti-cyclones for the separate months of 1883. The storm centres move northeastward with few exceptions.

(22) **Ch. Dufour:** Les lueurs crépusculaires de l'hiver 1883–1884. *Archives scient.*, 1885; 89–109. Regards the twilight glows as produced by reflection from suspended particles at a height of about 70 kilom., and ascribes their origin to Krakatoa. W. M. D.

(23) **Pernter:** Beitrag zu den Windverhältnissen in höhern Luftschichten. Sitz-Ber. Akad. Wisc. Wien, 1884, xc, 186.

Seven months' record of a self-registering anemometer on the summit of Hochobir (2,150 met.) in the eastern Alps, show northerly and easterly winds to be commonest and strongest; the wind shifts in the day time with the sun, but at night against it; maxima appear at 5–6 A. M. and 10–11 P. M., and a chief minimum from 2–3 P. M.

(24) **J. Hann.** Bericht über die Forschritte der geographischen meteorologie. (1882–83). *Geographisches Jahrbuch* Gotha, 1884; 57–114. A check list with brief notes, as in earlier numbers of this valuable compendium. American authors mentioned are chiefly Langley, on atmospheric absorption; Ferrel, barometric hypsometry; and several 'professional papers' of the Signal Service. Hann criticises Greely's "Isothermal lines" for lack of correction for altitude of station, "so that they have neither a scientific nor a practical value," but in this we can hardly agree with him. On the whole, the showing made for this country is much smaller than we should wish. W. M. D.

(25) **Laflamme:** Notes sur un fait météorologique particulier à Québec. Mém. Soc. Roy. Canada, 1884; 87–90. The wind blows, with few exceptions from the southwest or northeast; the first belongs to the prevailing westerlies, slightly deflected by the valley course; the second is thought to depend on the higher temperature prevailing during spring and autumn in the valley above Quebec than in the Gulf below. There is said also to be a wind up and down the valley produced in the absence of other causes by the great rise and fall of the tides, averaging twenty feet, in the gulf. W. M. D.

(26) **J. Hann:** Die Temperatur verhältnisse der österreichischen Alpenländer. I. Theil. Sitzb. Akad. Wiss. Wien, xc, 1884; 99p.

This extended and laborious memoir is the first step towards reducing the temperature observations taken in the eastern Alps since 1850. In order to make the results properly comparable, it is

considered essential to reduce them to the normal mean of the 30-year period 1851–1880; for the direct comparison of the means of different periods is not considered sufficiently accurate.* This reduction is to be accomplished by applying to the mean of the defective series of less than thirty years, a correction obtained from the records of the corresponding years at neighboring stations where the series is unbroken; and the paper is chiefly occupied in discussing the simplest and best method of determining this correction, in estimating its probable accuracy and in tabulating the necessary data. In the course of this work, the average variation of monthly, seasonal and yearly means is determined; winter months have the greatest variations, but in winter, elevated stations have generally a smaller variation than at low stations. Places visited by the foehn wind are recognized as having especially variable monthly means; and the variability increases rapidly on going inland from the Adriatic. The probable error of the means and the number of years required to reduce them to 0°.1 C. are also calculated. Thirty years suffices to attain this accuracy in the yearly mean; about 100 years would be needed to reach the same limit for the summer months; while the winter months would need from 300 to 400 years. The last twenty-five pages are occupied with tables for 27 stations, giving the departure of individual months from the means for every month and year from 1851 to 1880, preparatory to determining the reductions to the normal. Most of the special conditions are to be considered in a later paper, but the "inversion of temperatures" on high stations receives some attention here, and a good number of examples are given in which the departure of a monthly mean above its normal at a high station occurs with an abnormal cold at low stations. This anomaly occurs during prevalent high pressures and calms, while strong winds are productive of cold at elevated stations. A shorter paper on the method of reduction here used is given in Quart. Journ. Roy. Met. Soc., January, 1885.

(27) **Henry A. Hazen.** Tornadoes. Reprint from the *American Journal of Science*, vol. XXVIII, September, 1884.

A brief review of several contradictory theories, attributing the origin of tornadoes to great contrasts of temperature in adjacent bodies of air is given, and the author adds: "The theory that tornadoes occur where there are great contrasts of temperature in warm southerly and cool northerly winds, is not supported by facts. * * * It is admitted that immediately to the north and south of a storm center there are strong contrasts of temperature, and there is a partial meeting of warm and cool winds, but there are no tornadoes at or even near that point."

He states that tornadoes have been found invariably connected with large cyclones; and gives a table of forty-one of the most destructive tornadoes between September, 1872 and 1879, showing the place, time, distance of center of the primary cyclone, the temperature gradient, direction of winds near the tornado, distance to the nearest north wind, and pressure at the center of the primary cyclone. The mean distance from the center of the primary cyclone was 453 miles; mean distance S. 39° E.; mean temperature fall, ten degrees in 259 miles; and mean distance to the nearest north wind in 31 cases, 407 miles.

"Another most important point is the existence of extensive hail and thunder storms in the neighborhood of the tornado, which would seem to show an intimate relation between the two." The author refers to the primary cyclones as

* The author characterizes the method followed in Schott's memoir on the temperatures of the United States, where one year's record is compared with the mean of fifty years, as "unscientific and misleading;" but it is very doubtful whether many of the observations that Schott reduced deserved any better treatment than they received.

"lows." It is much to be regretted that the members of our Signal Service have adopted such inexpressive and undesirable terms, as descriptive of those large systems of circulating winds, which are mentioned in the scientific literature of almost every language as *cyclones*. To avoid confusion in popular and scientific language, it seems to me the Signal Service ought to adopt and popularize this term in its broadest sense, to counteract the limited meaning the newspapers have given it. H. H. C.

(28) **Bulletin of the Philosophical Society of Washington.** Vol. VII. Containing the minutes of the Society and of the Mathematical Section for the year 1884. Published by the co-operation of the Smithsonian Institution, Washington, 1885; LIX; 135 pages. This society was established in 1871 and has had 292 members on its rolls, of whom 41 are deceased and 173 are now active members. Being located at the center of government, its list must necessarily include the names of many of the most eminent scientific men of the United States. The volume of its bulletin before us has much of interest to meteorologists and physical geographers. We find such headings as Professor Eastman's "Rochester Tornado," Mr Johnson's "Some Eccentricities of Ocean Currents," Professor Hazen's "Sun-glows," (afterwards published in the *American Journal of Science*), Mr. Russell's "Deposits of Dust in the Great Basin," Mr. Diller's "Volcanic Sand which fell at Unalashka, Oct. 20, 1883," Mr. Doolittle's "Verification of Predictions," and others. Some of these papers we hope to republish in this journal. H.

(29) **S. Günther:** Der Einfluss der Himmelskörper auf Witterungsverhältnisse. Eine meteorologische Studie. 2d Ed. Nuremberg, 1884; 8vo; 69 pp. A candid, thorough, patient and critical examination of all that has been suggested as proving that the heavenly bodies exert an influence on our weather, concluding as follows: While it cannot be denied that such influence may appear in some way or other, it is certainly useless now, and will probably remain so for many years to come, as a means of long-range weather prediction. As to the moon, its effects may some day be learned; but it would be better for the science never to make this discovery than for the moon to be recognized as the general regulator of the weather as Falb, Overzier and others insist. The connection claimed between the sun-spot period and many diverse effects on the earth is thought to be as yet undemonstrated; investigation has shown rather that the most important causes of our secular variations of temperature are to be found, and will be found on the earth itself. W. M. D.

(30) **Oficina meteorológica argentina.** Informes anuales y documentos. (Extracto del tomo v.) 1885. The resignation of Dr. Gould, the founder and hitherto director of the office is announced; Walter G. Davis is appointed his successor. Annual reports for 1883 and 1884 are presented in brief by the retiring director. Mean hourly temperatures and pressures (1884) and solar radiation and rainfall for eleven years (1874–1884) are given for Cordoba. The mean monthly rainfall varies from 2mm. in July to 123.1 mm. in January. The diurnal barometric curve shows a low maximum (724.33) at 1 A. M., a faint minimum (724.24) at 4 or 5 A. M., a chief maximum (724.52) at 9 A. M., and a chief minimum (722.30) at 4 P. M. W. M. D.

(31) **Neumann und Partsch:** Physikalische Geographie von Griechenland. Breslau, 1885; 8vo; 476 pp. A valuable compilation for classical scholars as well as for geographers. 113 pages are given to the climate of Greece, from which the following extract is of general interest: Much has been written about the deterioration of Grecian climate, especially about the diminution of its rainfall. Springs have dried up and rivers that once flowed throughout the year now alternate between flood and dryness; districts formerly cultivated are abandoned. In spite of this, the authors conclude

that the evidence of decrease in rainfall is inconclusive. The ancient writers show clearly enough that even in classic times there were severe droughts, and that many streams ran only part of the year; disappearance of springs is but occasional, and is then connected with the cutting of neighboring forests, which also serves to explain the change in the régime of adjoining rivers. The decrease in the area under cultivation is ascribed in part to the decadence of the people. The diminution of rainfall is not denied, but the facts usually quoted to prove it are considered insufficient. The local winds are described with much detail, and their classical names are confronted with matter-of-fact barometric means.

W. M. D.

(32) **Brounow:** The motion of cyclones and anti-cyclones in Europe, especially in Russia. Zapiski Russ. Geogr. Soc. xii; 1884; 1. (in Russian) As noticed in Petermann's *Mittheilungen*, this article, based on original studies, gives the motion of storm-centres about parallel to the [mean?] isobars, or a little to the left, with the region of greatest warmth and humidity on the right of the track. The motion arises from the difference of temperature thus occurring in different parts of the storm. The greater constancy of storm tracks in North America than in Europe results from our stronger temperature gradient northward; the frequency of tracks in Russia to east-northeast in summer and to southeast in winter depends on the same conditions. The occasional motion of storms from east to west follows an excess of warmth in the north.

WOEIKOF: Der Einfluss der Wälder auf das Klima. Petermann's *Mittheilungen*, 1885; 81–87. This is a translation of a chapter from Woeikof's work on the "Climate of the Earth" (in Russian) by the author himself. He announces the following conclusions: Forests produce a considerable local increase of rainfall; in winter, this results from the small altitude of the rain-clouds, which are given a slight ascending motion in passing over woods, where the velocity of the wind is reduced; in summer, it seems to depend on the greater humidity of the air among the trees. The smaller evaporation under forest trees depends largely on the lessening of the wind, as well as on the shade, the high relative humidity of the stagnant air, and the lower temperature of the warmer months. The mean summer temperature is lowered not only within the forest, but for an appreciable distance around it. The destruction or the planting of forests is therefore perceptibly effective in causing climatic change; but it cannot go nearly so far as to produce or to overcome deserts.

W. M. D.

(33) **Report of the Tennessee Weather Service, Feb., 1885.** Published by the Bureau of Agriculture, Nashville; 24 pp., 6 tables and a map. The mean temperature was more than 11° below the mean of February last year and the average precipitation was 6.06 inches less. Thunder and hailstorms were pretty general on the 9th. The ground was reported from different stations as frozen from 1½ to 10 inches deep during the part of the month between the 9th and 27th. Brilliant sunsets continue to attract attention at intervals. A sunset exhibiting at the same time almost all the colors of the spectrum was reported from Riddleton on the 22d. The report contains a table showing the percentage of verifications of the cold waves predicted by the Signal Service during the winter. A glance at the table would lead one to believe that they had attained a wonderful degree of accuracy since every one is reported 100% verified, but a closer inspection shows that on one occasion the prediction was put down as 100% verified when the difference between the maximum temperature on the day on which the flag was elevated and the minimum on the day on which it was lowered was only 11°. On another occasion the difference was only 19°, on another only 20°, and on another only 26°, all set

down as 100% verified. Such difference between the maximum and minimum temperatures are of very common occurrence. During several successive days in the first part of April the differences between the maximum and minimum temperatures at Ann Arbor, Mich., was nearly 25°. This shows the erroneous impressions that are apt to be derived from the method of estimating verifications employed by the Signal Service without taking into consideration the average occurrence of phenomena or the law of probabilities. This was illustrated by Gilbert's article in the September No. of this JOURNAL. H. H. C.

(34) **Report of the Indiana Weather Service, for February 1885, and the Winter of 1884–5.** Compiled at De Pauw Univ., Greencastle, Ind., under the direction of Prof. W. H. Ragan.

The report contains a summary of observations taken at forty different points in the state and consists of a table giving the highest, lowest and mean temperatures and a table of comparative temperatures. Both the month and season were remarkable for low temperature and excessive snowfall. The most marked meteorological feature of the month was the passage, from southwest to northeast, of the great cyclone of the 8th and 9th across the state, and its accompanying thunderstorms, rain, sleet, and snow, with the cold wave that formed the western part of and followed the storm.

H. H. C.

(35) **Weekly Rainfall Circular;** Issued by Mr. L. N. Jesunofsky, observer at the Nashville Signal Office, contains each week the average rainfall of the week over each of the four districts of the cotton belt, and of each of the four Signal Service stations in Tennessee separately, together with the precipitation over the same districts, at the same time, during the two preceding years, for comparison.

These circulars are of value, and are utilized by agriculturists, members of boards of trades, physicians, meteorologists, and others interested in the current changes of the weather as bearing on their several professions. They have been issued for several years and I believe are not required by the Signal Service, but Mr. Jesunofsky has been untiring in his efforts to make the data collected at, and passing through his office of benefit to the community, and this has been one of the methods employed. H. H. C.

(36) **Monthly Weather Review, February, 1885, Meteorological Service Dominion of Canada.** Charles Carpmael, Supt., Toronto. The first two pages are devoted to atmospheric pressure and the movement of cyclones and anti-cyclones over the territory. A table of the minimum temperature is next given. These ranged from —1.2 at Halfax to —48.3 at St. Andrews, Manitoba. The temperature fell more than 20° below zero at most of the stations, and more than 40° below at nine. The mean temperatures of the month were decidedly below the average. The rainfall was below the average in all of the districts and the snowfall in most of them considerably above. Monthly snowfalls of over 20 inches were reported from a large number of places. A table is given showing the proportion of sunshine registered each hour of the day during which the sun was above the horizon. It shows a decided preponderance of the amount of sunshine during the middle of of the day. The maximum was about 1 P. M. The diagram of the wind shows a decided preponderance of the winds from some westerly direction. 79.5% of the predictions of the service were estimated as fully verified; and 92% as fully or partially verified. H. H. C.

(37) **Missouri Weather Service.** Francis E. Nipper, Director Washington University, St. Louis. The reports contain general summaries and remarks,

with a table giving a brief summary of the observations taken at 35 stations, accompanied by a map on which rainfall lines are drawn. There have also been issued with the reports, from time to time, diagrams showing the mean temperatures for given months, observed by Dr. Engelman during more than forty years, which prove exceedingly interesting for comparison. These diagrams show that the present winter has been the coldest on record (1837—'85). The mean temperature of March has been 3.6° below normal, and the precipitation quite small. H. H. C.

(38) **Diagram showing the Mean Monthly Temperatures at Boston, Mass., 1871 to 1880.**—Compiled from published records of U. S. Signal Service, by John M. Batchelder, Cambridge, Mass.

By means of lines of different lengths, arranged in groups for each month, the mean temperature of every month from 1871 to '80 is graphically represented. The coldest month was January, 1875, with mean temperature of about 21°; and the warmest was July, 1872, with a mean temperature of about 74°.

H. H. C.

(39) **Meteorology of Oakland, Cal.,** for 1882-3, and 1883-4, by J. B. Trembly, M. D. 35 pp.

This is an interesting little pamphlet, giving tables of statistics and remarks showing the mean temperature, total rainfall, etc., at Oakland, for 1882–83 and 1883–4, together with less complete data for several years back. Short dissertations on the history of California, and on the "modifying causes of the climate of the Pacific Coast of the United States and British Columbia," are also given.

(40) **Report of Meteorological Observations made at Rousdon Observatory, Devon, England, during 1884,** under the superintendence of Cuthbert E. Peck, M. A., F. R. Met., Soc., etc.; 17 pp.; 4 plates.

The observatory is situated near the coast at a height of 524 feet above mean sea level, and commands a fine view of the surrounding country. The situation is therefore free from any purely local causes, and decidedly favorable for the study of atmospheric phenomena.

The reader is not troubled in the report with long tables of statistics; but the general conditions of the weather for each month are given in brief notes, as regards pressure, wind, rain, temperature, and the most interesting casual phenomena. One of the most interesting occurrences during the year was the great storm of Jan. 26, when the movements of the barometer were visible to the eye. The yearly rainfall was 2.49 in. below the normal. There was a severe drought during the autumn. The hottest day during the year was Aug. 8, max. temp. 79°; the coldest Nov. 30, min. tem. 26°.

A curve of the mean monthly temperatures at Greenwich, compared with the curve obtained for Rousdon, shows that the temperature was higher at Greenwich in summer, and lower in winter, than at the observatory, as was to be expected from the difference in elevation.

H. H. C.

(41) **Meteorological Summary, from Stations of the Indiana Volunteer Weather Service for March 1885.** Prof. W. H. Ragan, De Paun, Univ.

Two tables are given, one containing the highest, lowest and mean temperatures, and total precipitation from twenty stations, and the other comparative means. "From all stations the temperature is reported as having been far below the normal and the precipitation extraordinarily small." H. H. C.

(42) **Minnesota State Weather and Crop Report Service.** Wm. M. Payne, Dir., Carleton College, Northfield.

An interesting summary of the general weather and tables containing complete summaries of observations taken at six stations are given. March, like the three preceding months, opened with a mild temperature which continued until the 14th. From the 14th to the 26th the temperature remained much below the

normal, and from the 26th to the end of the month there was a marked increase in temperature. The snow melted rapidly and the ice in the rivers and lakes began to soften and break up.

H. H. C.

CORRESPONDENCE.

INCREASE IN WIND VELOCITY TOWARD NOON AND A LITTLE AFTER.

To the Editor—The explanation of the diurnal change in wind velocity toward the warmer part of the day as found on page 552 of this Journal is unique, but I hardly think tenable. This change, in some instances, amounts to 100%, that is, the mean wind velocity at 2 P. M. is double that at 7 A. M. Now the amount of change in pressure, due to the diurnal range, is entirely too small to produce any such increase in wind velocity. Moreover, we must bear in mind that this change in pressure is by no means local, but takes place nearly simultaneously over an immense region, *e. g.*, taking the time of daily maximum pressure at 10 A. M. and that of daily minimum at 4 P. M., the region over which the change is taking place becomes over 6,000 miles in length; as the total daily range amounts to only .1″ or even less, this would give a barometric gradient of about .001″ in 1°, (69 miles) at the equator, an amount insufficient to produce a perceptible breeze. The usual explanation of this increase is only a little more satisfactory, however. It has been suggested that at the warmer part of the day the heat produces rising currents, which, at the same time whirls more or less, and these whirls increase the wind velocity. This ingenious explanation needs confirmation; can this be obtained by turning the cups of the common Robinson anemometer so that they would revolve counter clock-wise or in the opposite direction from the present? We know that the tendency of all whirls is counter clock-wise. I have repeatedly noticed whirls in the city and country and in more than 95% of the cases they have been counter clock-wise. One important consideration to be kept in mind is that as we ascend in the air this diurnal change in wind velocity undergoes a remarkable change, for at the height of Mt. Washington, 6,300 feet, the maximum comes at 7 A. M. or precisely at the time of the sea level minimum and the minimum at the hottest part of the day. The explanation of this anomaly has been given as follows: At the heated part of the day there are rising currents of air which arise above the summit and act as an obstruction to the free course of the wind; thus that which increased the velocity at sea level seems to diminish it at a height. It is probable that at the going down of the sun the denser air settles down and renders the movement of the wind more difficult, and as this settling continues until the next morning at sunrise the velocity of wind diminishes till the same time. The problem is one of great interest. We need to know the law of diurnal change at various heights by means of skeleton towers or by captive balloons. Observations on hills are extremely unsatisfactory, because of the configurations of the sides.

H. A. Hazen.

MORRIL'S REPORT UPON OBSERVATIONS OF ATMOSPHERIC ELECTRICITY.

To the Editor:—Observations on atmospheric electricity, we are glad to say, have been carried on for more than a year at two points in the United States—Havard and John Hopkins Universities. This first report by Mr. Morrill, of the Signal Service, who has had charge of

the instrument at John Hopkins, is a very interesting one. He states that barometrical variations seem to have no direct relation to the electrical changes; and "with respect to varying cloudiness, there are the same continuous fluctuations of the needle on a perfectly clear day, as with passing clouds or complete cloudiness." He shows that rainfall was almost invariably preceded by a falling potential, and that this fall began from two to twenty hours before the commencement of rain. During northwest winds the potential curve was found to be nearly the reverse of the velocity curve of the wind, maxima of wind corresponding to minima of potential. When the wind veered through the east the potential rose, when it backed through the east the potential fell. After calms when the wind rose from an east or south quarter the potential rose, when from a north or west quarter the potential fell. He concludes that "there seems to be an indication that north (to west) winds are accompanied by a low potential; south (to east) winds by a high potential." Rapid and remarkable oscillations of the potential were found to be characteristic of every snow-storm. Besides the fact pointed out by Mr. Morrill, that during south to east winds the potential tended to be higher than during north to west winds, a study of the curves accompanying his paper leads me to conclude that the diurnal oscillations of potential were in nearly opposite directions when northeast to south winds prevailed, to what it was during the continuance of southwest to north winds.

From the curves given by Mr. Morrill all those days on which the wind blew almost constantly from the easterly section and during which the potential curve was continuous were selected. These are given in the first column of table I. In a similar manner all those days on which the wind blew almost constantly from the westerly section were selected. These are given in the first column of table II. The second column in both tables contains approximately the times according to the twenty-four hour system at which the potential attained its maximum on each of the dates given, as determined from the curves. The third column in each table contains approximately the time the potential reached its minimum. 0 h in the table indicates the midnight preceding (or beginning) the date given, and 24 h the midnight following (or ending) the date given. It will be seen from table I that, during the prevalence of winds between N. E. and S., the maximum potential was usually reached about noon or during the afternoon, and the minimum about midnight; while table II shows that, with winds between S. W. and N., the potential usually reached its maximum during the early morning or about sunrise, and its minimum during afternoon, thus giving a curve the reverse of the wind velocity—as Mr. Morrill has noticed—though they are not necessarily cause and effect.

TABLE I.
Easterly Winds.

Date.	Time of Max. Potential.	Time of Min. Potential.
Mar.		
5	12 h	24 h
6	12	23
7	12	24
8	14	2
11	13	24
14	15	23
23*	24	12
25	15	24
Apr.		
1	18	24
8	snow	
15	10	18
20	12	14
22	17	7
24	10	1

TABLE II.
Westerly Winds.

Date.	Time of Max. Potential.	Time of Min. Potential.
Mar.		
15	24 h	0 h
27	10	17
30	12	20
31	19	9
Apr.		
3	3	15
4	7	14
5	6	9 & 19
6	8	23
7	7 & 22	21
9	snow	
10	8	0
11	9	3
13	2	9
17	3	12
18	24	10 & 17
19	0	19

* Heavy rain.

A single diurnal oscillation of the potential is very apparent in the curve for a number of days; but on none of the days do I find any appearance of the

double diurnal oscillation, such as has been found at other places, though a process of averaging might show it.

Judging from the winds, temperature, and rainfall curves (the barometric curve is not given), I should think that, if the diurnal and rapid oscillations were smoothed out, the potential curve would have oscillated in an opposite manner to the pressure curve during the time given. Observations on atmospheric electricity, when extensively carried out, will undoubtedly, greatly facilitate the predictions of local storms, and rainfall which is now one of the most difficult of weather changes to predict, at least quantitatively.

H. Helm Clayton.

RELATION OF ELECTRICITY TO TORNADOES.

To the Editor:—On page 551 of the April number of this Journal, a statement is made that only 17 out of 600 tornadoes, described by Mr. Finley, showed electric action in the cloud. It is universally admitted that hail has a prominent connection with if not invariably produced in a thunderstorm. The records of Mr. Finley are by no means as complete as might be wished, but since he attempts to record both, when there has been no electric action, and when there has been such, we have a fairly satisfactory means of determining the number of tornadoes with no action and with some action. Out of 573 tornadoes the total number of records of hail, lightning, thunder, or none were 224, of them 215 or 96% were of electric action. Surely this is sufficient evidence of electric action. I challenge any one to bring forth positive evidence of a tornado having no electric action either immediately in the cloud itself or within a few miles.

H. A. Hazen.

GRAVITY CORRECTION.

To the Editor:—An article on gravity correction for barometric readings, in the April number of this Journal, calls for the following comments.

The writer compares the amount of this correction between the most northerly and the most southerly stations in the U. S. (.07″), with the correction for temperature at 55°. It must be plain to nearly every one that the two are not at all comparable. There may be two stations, for example, one lying 25 miles due north of the other. The one with barometer at a temperature of 32° and the other at 55°; in such case, but before comparison can be made between barometer readings at the two, a correction for temperature amounting to .071″ at 30″.00 must be applied to the 2d, while for gravity the correction would be .0005″ an amount entirely inappreciable. It is equally plain that no direct comparison will ever need to be made between barometer readings 2,500 miles apart.

The writer of the article ignores the usual argument used in favor of the gravity correction, namely, that it will enable a direct comparison between observations with aneroid and mercurial barometers (though, since aneroid readings are invariably in great doubt, such a refinement as this one proposed seems a useless labor, save for mean charts). The writer, does, however, come to the rescue of this refinement, which he calls "important and necessary," with such an astonishing argument that it may be well to examine it a little. He says, "this difference of barometer readings" (due to gravity and amounting to .08″ from the equator to 45°) that it "would ordinarily be taken to indicate actual differences of pressure and effective poleward gradients; such as should cause winds, also, "until correction for latitude is made the poleward gradients will always appear steeper than they really are."

Attempts at determining the relation between winds and barometric gradients have met with varied results depending largely on the methods of investigation. Peslin has found that with winds at 5 miles per hour, the lowest he has discussed, the gradient amounted to .7^{mm} per degree (69 miles), *i. e.*, a fall in pressure of .7^{mm} in 69 miles gave a velocity

of wind of 5 miles per hour; this would give less than 1 mile per hour for a gradient of .1^{mm} an amount of wind, by itself, entirely insensible to an ordinary anemometer. Taking the theoretical fall in pressure due to gravity of .4^{mm} between 0° and 90° latitude, we have a gradient of .044^{mm}, giving approximately a velocity of $\frac{1}{4}$ of a mile per hour, or less than $\frac{1}{2}$ of a foot per second. A velocity of more than double the latter is needed to move the blades of a most delicate air metre. Verily, "*parturiunt montes nascetur ridiculus mus.*"

X.

REMARKABLE SUNSET.

To the Editor:—On the 1st inst., a few minutes after sunset, the sky presented a very remarkable appearance to observers at this station. It was entirely cloudless, and tinged with bright, deep blue, increasing in intensity of color from west to east. As the color was far more intense than that of the ordinary clear, blue sky, it could not have been mistaken for such. A light haze observed in the mountains east of station was also tinged with blue. Was the observation of the above general, and what was the probable cause?

Very respectfully,
Your obedient servant,
W. S. Mayers,
Signal Corps.

Fort Apache, Arizona, April 12, '85.

LIGHTNING IN CALIFORNIA.

To the Editor:—It is frequently stated by Californians that they have neither thunder nor lightning, and that fewer people are killed there by earthquakes than are killed by lightning, in the Eastern States. Are these statements true? If so, how can they be accounted for? H. A. B.

St. Paul, Minn.

[The relative infrequency of lightning is not to be doubted. The distribution of the phenomena of a disruptive discharge of atmospheric electricity is curious, and worthy of detailed study. For instance, lightning is rare on the west coast from the Arctic to Cape St. Lucas. It is extremely common in Jamaica. Thunder Bay in Lake Superior, and the bay of the same name in Lake Huron, are said to be named from the frequency of thunder in them. Some one should draw up a map of the relative frequency of lightning. As to fatality from lightning in California, we remember reading somewhere that the first fatal lightning stroke there, after settlement by Yankees, was at Dry Creek in 1854, and was published by the *Shasta Courier*. Since then occasional fatal strokes have been published. Ed.]

DIURNAL CHANGE IN WIND VELOCITY.

To the Editor:—The explanation given in the April number of the cause of the diurnal change in wind velocity, does not seem as satisfactory to me as the one given by Espy (Fourth Met. Report, p. 214), and Köppen. It has been ascertained by numerous observations, that the wind nearly always increases in velocity with the height above the earth's surface; and according to the theory mentioned, the ascending and descending currents which are formed during the day transfer the air from above with its greater velocity to the earth's surface, and transfer the air with its lesser velocity from near the earth's surface to the upper currents. Accordingly observations on mountain tops, and with kites (Archibald) have shown that the wind blows with less velocity above, during the day than during the night.

I find it stated by some writers that, in estimating wind velocities from a given gradient, allowance has to be made for the daily variation in velocity. This would not be necessary if the daily variation itself was due to a gradient.

H. Helm Clayton.

Ann Arbor, April 15, '85.

"THERE IS SNOW IN THE AIR."

TO THE EDITOR:—I hear weather-wise elderly people using the expression, even on warm spring days, "There is snow in the air—we will not have warm weather until it comes down." This was said a few days ago on a fine, warm spring day, and proved to be correct. What is the scientific expression for "there is snow in the air?" and how would it appear in meteorological observations?

A. T.

SYCAMORE, ILL., April 15, '85.

[Perhaps some of our readers can answer the above question. ED.]

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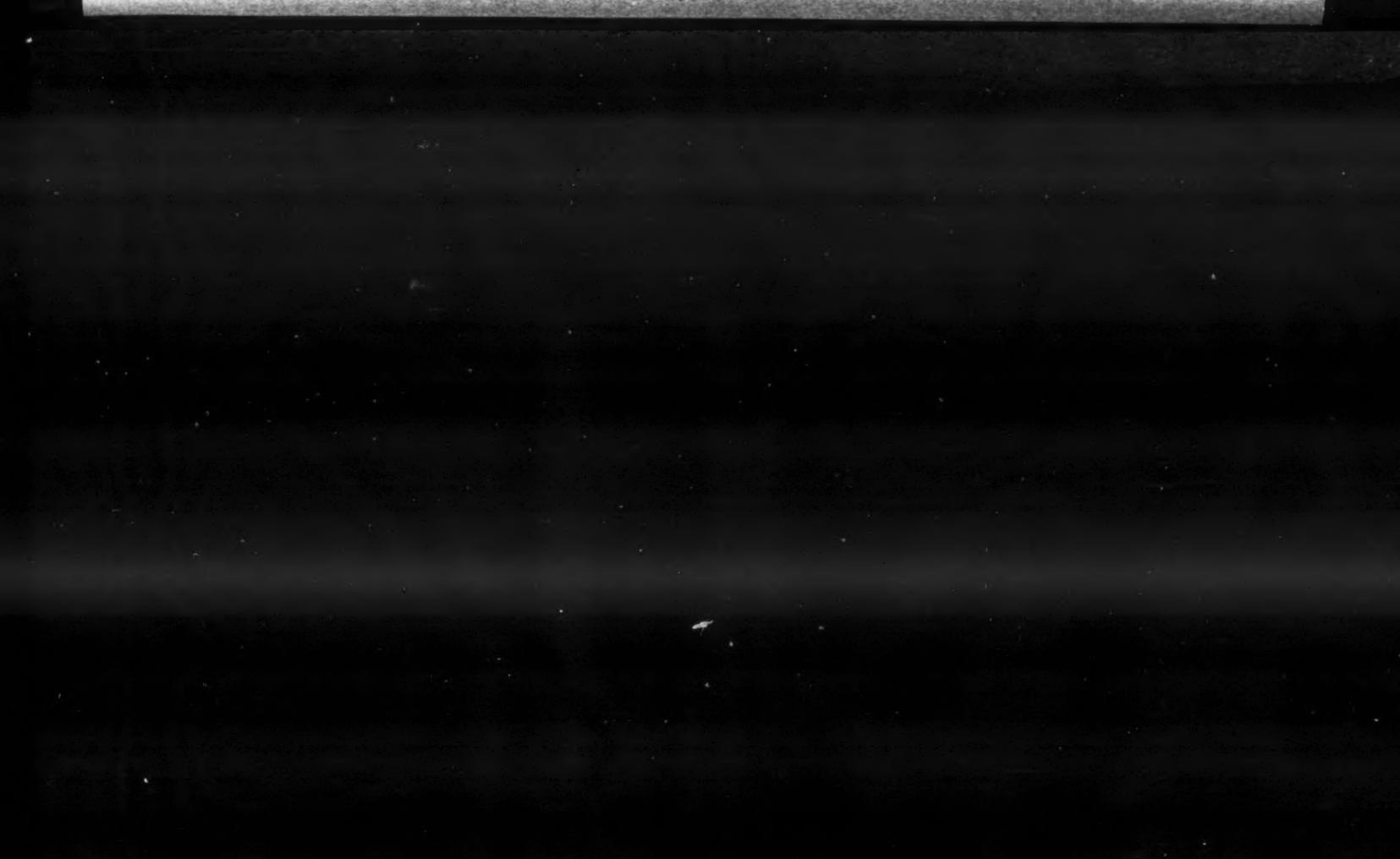

AMERICAN METEOROLOGICAL JOURNAL.

AN ILLUSTRATED MONTHLY

DEVOTED TO SCIENTIFIC METEOROLOGY AND ALLIED BRANCHES OF STUDY.

W. H. BURR PUBLISHING CO., Publishers and Proprietors.
Mechanics' Block, DETROIT, MICHIGAN.

—EDITED BY—

M. W. HARRINGTON,
Director of the Astronomical Observatory, Ann Arbor, Michigan.

PRICE,—IN THE UNITED STATES, ... $2.00 PER YEAR.
" IN COUNTRIES OF THE POSTAL UNION, ... 2.25 " "

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Ann Arbor, Mich., Oct. 1st, 1884